NOTE

This Microfiche meets the quality requirements of the American National Standard for Microfiche of Documents (ANSI PH5.9-1975). However, because of imperfections in the document from which it was made, it contains images that are illegible or difficult to read. The source document for this microfiche is the best copy that could be obtained prior to filming.

CIS

Congressional Information Service
Washington, D.C.

THE NATIONAL AERO-SPACE PLANE

JOINT HEARING

BEFORE THE

SUBCOMMITTEE ON TRANSPORTATION,
AVIATION AND MATERIALS

OF THE

COMMITTEE ON
SCIENCE, SPACE, AND TECHNOLOGY

AND THE

SUBCOMMITTEE ON RESEARCH AND DEVELOPMENT

OF THE

COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED FIRST CONGRESS

FIRST SESSION

AUGUST 2, 1989

[No. 53]
(Committee on Science, Space, and Technology)

[H.A.S.C. No. 101-23]
(Committee on Armed Services)

Printed for the use of the Committee on Science, Space, and Technology
and the Committee on Armed Services

U.S. GOVERNMENT PRINTING OFFICE
22-487 WASHINGTON : 1989

For sale by the Superintendent of Documents, Congressional Sales Office
U.S. Government Printing Office, Washington, DC 20402

H201-79
H701-99

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

ROBERT A. ROE, New Jersey, *Chairman*

GEORGE E. BROWN, Jr., California
JAMES H. SCHEUER, New York
MARILYN LLOYD, Tennessee
DOUG WALGREN, Pennsylvania
DAN GLICKMAN, Kansas
HAROLD L. VOLKMER, Missouri
BILL NELSON, Florida
RALPH M. HALL, Texas
DAVE McCURDY, Oklahoma
NORMAN Y. MINETA, California
TIM VALENTINE, North Carolina
ROBERT G. TORRICELLI, New Jersey
RICK BOUCHER, Virginia
TERRY L. BRUCE, Illinois
RICHARD H. STALLINGS, Idaho
JAMES A. TRAFICANT, Jr., Ohio
LEE H. HAMILTON, Indiana
HENRY J. NOWAK, New York
CARL C. PERKINS, Kentucky
TOM McMILLEN, Maryland
DAVID E. PRICE, North Carolina
DAVID R. NAGLE, Iowa
JIMMY HAYES, Louisiana
DAVID E. SKAGGS, Colorado
JERRY F. COSTELLO, Illinois
HARRY JOHNSTON, Florida
JOHN TANNER, Tennessee
GLEN BROWDER, Alabama

ROBERT S. WALKER, Pennsylvania*
F. JAMES SENSENBRENNER, Jr., Wisconsin
CLAUDINE SCHNEIDER, Rhode Island
SHERWOOD L. BOEHLERT, New York
TOM LEWIS, Florida
DON RITTER, Pennsylvania
SID MORRISON, Washington
RON PACKARD, California
ROBERT C. SMITH, New Hampshire
PAUL B. HENRY, Michigan
HARRIS W. FAWELL, Illinois
D. FRENCH SLAUGHTER, Jr., Virginia
LAMAR SMITH, Texas
JACK BUECHNER, Missouri
CONSTANCE A. MORELLA, Maryland
CHRISTOPHER SHAYS, Connecticut
DANA ROHRABACHER California
STEVEN H. SCHIFF, New Mexico
TOM CAMPBELL, California

Harold P. Hanson, *Executive Director*
Robert C. Ketcham, *General Counsel*
Carolyn C. Greenfeld, *Chief Clerk*
David D. Clement, *Republican Chief of Staff*

Subcommittee on Transportation, Aviation and Materials

TIM VALENTINE, North Carolina, *Chairman*

DAN GLICKMAN, Kansas
DAVE McCURDY, Oklahoma
BILL NELSON, Florida
TOM McMILLEN, Maryland
GEORGE E. BROWN, Jr., California
(Vacancy)

TOM LEWIS, Florida
CHRISTOPHER SHAYS, Connecticut
DANA ROHRABACHER California
TOM CAMPBELL, California

---

*Ranking Republican Member.

HOUSE COMMITTEE ON ARMED SERVICES

ONE HUNDRED FIRST CONGRESS

LES ASPIN, Wisconsin, *Chairman*

CHARLES E. BENNETT, Florida
G.V. (SONNY) MONTGOMERY, Mississippi
RONALD V. DELLUMS, California
PATRICIA SCHROEDER, Colorado
BEVERLY B. BYRON, Maryland
NICHOLAS MAVROULES, Massachusetts
EARL HUTTO, Florida
IKE SKELTON, Missouri
MARVIN LEATH, Texas
DAVE McCURDY, Oklahoma
THOMAS M. FOGLIETTA, Pennsylvania
ROY DYSON, Maryland
DENNIS M. HERTEL, Michigan
MARILYN LLOYD, Tennessee
NORMAN SISISKY, Virginia
RICHARD RAY, Georgia
JOHN M. SPRATT, JR., South Carolina
FRANK McCLOSKEY, Indiana
SOLOMON P. ORTIZ, Texas
GEORGE (BUDDY) DARDEN, Georgia
ALBERT G. BUSTAMANTE, Texas
GEORGE J. HOCHBRUECKNER, New York
JOSEPH E. BRENNAN, Maine
OWEN B. PICKETT, Virginia
H. MARTIN LANCASTER, North Carolina
LANE EVANS, Illinois
JAMES H. BILBRAY, Nevada
JOHN TANNER Tennessee
MICHAEL R. McNULTY, New York
(Vacancy)

WILLIAM L. DICKINSON, Alabama
FLOYD SPENCE, South Carolina
BOB STUMP, Arizona
JIM COURTER, New Jersey
LARRY J. HOPKINS, Kentucky
ROBERT W. DAVIS, Michigan
DUNCAN HUNTER, California
DAVID O'B. MARTIN, New York
JOHN R. KASICH, Ohio
HERBERT H. BATEMAN, Virginia
BEN BLAZ, Guam
ANDY IRELAND, Florida
JAMES V. HANSEN, Utah
JOHN G. ROWLAND, Connecticut
CURT WELDON, Pennsylvania
JON L. KYL, Arizona
ARTHUR RAVENEL, JR., South Carolina
ROBERT K. DORNAN, California
JOEL HEFLEY, Colorado
JIM McCRERY, Louisiana
RONALD K. MACHTLEY, Rhode Island

G. KIM WINCUP, *Staff Director*

RESEARCH AND DEVELOPMENT SUBCOMMITTEE

RONALD V. DELLUMS, California, *Chairman*

DAVE McCURDY, Oklahoma
THOMAS M. FOGLIETTA, Pennsylvania
DENNIS M. HERTEL, Michigan
GEORGE (BUDDY) DARDEN, Georgia
GEORGE J. HOCHBRUECKNER, New York
OWEN B. PICKETT, Virginia
MICHAEL R. McNULTY, New York
CHARLES E. BENNETT, Florida
PATRICIA SCHROEDER, Colorado
BEVERLY B. BYRON, Maryland

WILLIAM L. DICKINSON, Alabama
ROBERT W. DAVIS, Michigan
BOB STUMP, Arizona
DUNCAN HUNTER, California
CURT WELDON, Pennsylvania
JON L. KYL, Arizona
ROBERT K. DORNAN, California

CARL T. BAYER, *Professional Staff Member*
MARLYN A. ELROD, *Subcommittee Professional Staff Member*
ANDREW K. ELLIS, *Professional Staff Member*
THOMAS S. HAHN, *Counsel*
MARY E. VESELY, *Staff Assistant*
WILLIAM J. ANDAHAZY, *Congressional Fellow*

CONTENTS

WITNESSES

August 2, 1989:

Page
- Hon. Donald B. Rice, Secretary, U.S. Air Force 6
- Adm. Richard H. Truly, Administrator, National Aeronautics and Space Administration 13
- William R. Graham, Senior Vice President, Jaycor 83
- Gen. Laurence Skantz, U.S. Air Force (Ret.) 88
- Bruce R. Abell, Senior Research Fellow, Hudson Institute 97
- Frank J. Gaffney, Jr., Director, Center for Security Policy 105

Appendix—Statements of:

- Anthony A. duPont, President, duPont Aerospace Co., Inc 137
- John A. Guthrie, Laser Radio 152

THE NATIONAL AERO-SPACE PLANE

WEDNESDAY, AUGUST 2, 1989

House of Representatives, Committee on Science, Space, and Technology, Subcommittee on Transportation, Aviation and Materials; Committee on Armed Services, Subcommittee on Research and Development,

Washington, DC.

The committees met, pursuant to notice at 10:14 a.m., in room 2118, Rayburn House Office Building, Hon. Ronald V. Dellums presiding.

Present: Representatives Dellums, Lewis, McCurdy, Rohrabacher, Valentine, and Walker.

Mr. Dellums. The hearing will come to order.

This morning we meet in joint hearings between the House Armed Services Committee's Subcommittee on Research and Development and the House Science, Space, and Technology Committee's Subcommittee on Aviation, Transportation and Materials.

The Chair would like to note that both parties unfortunately are presently meeting in various caucuses and that speaks to the fact that we have very few members here this morning.

Today we will address the matter of the National Aero-Space Plane. The program which began in DARPA. It's aimed at developing a transatmospheric vehicle that can take off like an airplane, leave the Earth's atmosphere and return. The work which began in 1982 is now in its second of three phases and appears to be fighting for survival as a joint program between the Department of Defense and NASA.

After initially being terminated in DOD in the fiscal year 1990 authorization request, the program was reinstated by the House Armed Services Committee's Subcommittee on Research and Development. Subsequently, the program was reviewed by the National Space Council for potential revision of the administration's position.

The recommendation by the Space Council adopted by the administration called for revision of fiscal year 1990 request to $254 million, equally divided between the two agencies, DOD and NASA with the stretch-out of the program significantly delaying both the decision to build a test vehicle as well as a planned flight test.

As the Chair understands, many of the scientific community did not agree with that stretch-out and believed that any delay from the original schedule contributes to potential loss of leadership in the field of hypersonic technology.

There has been much activity over the last several weeks regarding the fate of this program. Today we hope to make clear an understanding of the program's plan and options before we begin a conference with the Senate which is anticipated shortly after the Congressional recess.

Today it is my pleasure to welcome a number of witnesses, among them the Honorable Donald Rice, Secretary of the Air Force; the Honorable Richard Truly, Administrator of NASA; as well as the distinguished panel of scientists that I will name at the appropriate point in time.

We will also hear from a witness from the General Accounting Office regarding the program.

The Chair would like to welcome all of the witnesses this morning.

And the Chair would yield to any of my colleagues on the other side of the aisle who would like to make any comments at this time, whatever comments they deem appropriate, the Chair would recognize the gentlemen.

The gentleman from Pennsylvania.

Mr. **Walker**. Mr. Chairman, a robust National Aero-Space Program is critically important for the U.S. technology space policy national security. And therefore I am very pleased our two subcommittees have joined together today to give a full hearing of the status of NASP.

Ours is a privileged generation. For much of our lifetime America has been at peace and our Nation has prospered. Thanks in no small measure to U.S. excellence and leadership in science and technology.

Members of these committees need no reminder of today's serious challenge to America's economic preeminence. Foreign competitors recognize that science and technology hold the key to their future economic and military well being, and have invested aggressively to upgrade their capabilities.

The result has been a steady decline in U.S. world market share including, as of this decade, in high technology. The aeronautics industry has been a key exception to this adverse trend where the United States has continued to dominate the market share. But as other nations increase their capabilities and efforts, we can no longer take American preeminence for granted.

In order to preserve U.S. aeronautical superiority we must have national programs to support bold new technological thrusts. Two Presidents, with the support of Congress, have singled out the National Aero-Space Plane as pioneering, leading-edge technology in aviation and aerospace. And to date, the program successes have been extraordinary.

So it will come as no surprise that many members of our two committees were shocked by the administration's announced decision to delay the pace of NASP by 2½ years.

According to the White House press release, the new reduced budget "plan extends technology development until early 1993 to reduce technical and cost risks."

I do not understand that kind of reasoning. If there are concerns that the program is too technically risky, cutting funds available to reduce those risks obviously will not solve the problem.

Even more to the point, the whole purpose of the NASP Program is to take risks. NASP was conceived to accelerate our technology—not to rest on existing technology. The objective is to push the envelope of what we know how to do and to achieve new technological breakthroughs. To develop a machine capable of atmospheric air-breathing propulsion to nearly orbital velocities requires a very special kind of material and very special engine technologies that were thought nearly impossible just a short time ago.

Risk and technological achievement go hand in hand. We have challenged the aerospace industry to leap from incremental improvements to real revolutionary designs in concepts. And from all I have seen, they are rising to the challenge. They should be supported and encouraged and applauded, not hamstrung.

What I suspect is that decision to stretch out NASP is really budget-driven. And I must say that that disturbs me. While I appreciate the budget constraints that we face, it makes no sense to cut the very programs that hold the greatest promise for economic as well as national security return.

I applauded the President's July 20th speech in which he set forth broad and exciting visions for America's future space ventures. But the first step of any space program, whether ambitious or minimalist, is assured access to space and to that end, NASP is critical.

I am concerned that if we cannot find the resources and national resolve to support a robust NASP Program, we will loose precious ground in technological competition. We will jeopardize the important national security objectives and the President's goals for America's future in space will never be achieved.

I would like to see the NASP Program accelerated rather than slowed down. And I hope that today's joint hearing and the testimony of both government witnesses and distinguished outside experts will help lay a record for Congress to decide the funding and effort we should devote to the National Aero-Space Program.

Thank you.

Mr. DELLUMS. I thank the gentleman for his opening remarks and the Chair will now yield to my distinguished colleague, Mr. Valentine, the Chairperson of the Aviation, Transportation and Materials Subcommittee for such comments as the gentleman deems appropriate at this time.

Mr. VALENTINE. Thank you, Mr. Chairman.

We are pleased to be joining our colleagues from Armed Services Research and Development Subcommittee today for the purposes of reviewing the progress of the National Aero-Space Plane Program, one of the more promising high technology projects our country has ever undertaken.

This is the fourth year in which the funds have been requested specifically for the joint NASA/DOD project. After several intervals, the administration request for fiscal year 1990 now stands at a total of $254 million; $127 million for the Air Force, and $127 million for NASA.

This year, in addition to our usual interest in reviewing the program's technical progress, we want to examine carefully the circumstances that led to its consideration by the National Space Council under the Vice President.

We have been told that a delay in funding will save in fiscal year 1990—a DOD contribution goes from $300 million to $127 million, but will the delay cost more in the long term? Furthermore and perhaps more importantly, will it jeopardize the very substantial contributions that private companies have made to the program because they believed that the government was serious? Will they pull their horns in to wait and see what the next action of the government will be?

Let me say that I am a strong believer in the potential of the NASP Program. I am highly skeptical that the delay will enhance the program. I fear that budget considerations were given undue weight. The only probable beneficiaries are the Japanese and Europeans, who are already well along with their own programs.

Two other issues concern me, Mr. Chairman, and members of the joint subcommittee. One is whether the Air Force, which has never been a strong advocate of the program, will now give it sufficient priority in its budget preparation. If not, I would suggest we consider returning management responsibility to Defense Advance Research Projects Agency, or DARPA.

The other issue is whether the research character of the program can be preserved. The NASP vehicle, the X-30, will be another in a long line of research vehicles, like Chuck Yeager's X-1. That vehicle was a stripped-down model designed to do only one thing. Break the sound barrier. Likewise, the X-30 is or should be, and I underscore the words "should be," a research vehicle designed to do one thing and that is achieve orbital speed with an air-breathing engine. If we ask it to do anything else, the vehicle will get heavier, more complex, and more costly. And we can't stand any of those things at this particular time.

I feel, Mr. Chairman, these are key issues affecting the eventual success or failure of the whole program. And I hope that we can get a clearer understanding of them here today.

Thank you.

Mr. **Dellums**. I thank the gentleman for his opening statement.

The Chair would now like to recognize the distinguished gentleman from Florida, Mr. Lewis, the ranking minority member of the subcommittee for such comments as he deems appropriate at this time.

Mr. **Lewis**. Thank you, Mr. Chairman.

The National Aero-Space Plane Program is very important for the development of new aerospace technology and for the nation's economic health.

Through the NASP Program, new and innovative technology is being developed in materials to withstand enormous temperature-air-breathing engines that will reach a speed of Mach 25. Computor imaging that permits design-flaw detection before it leaves the drawing board. And many more with the flight of the X-30.

U.S. Aero-Space Plane technology will thrust—number one world-wide—into the 21st Century. To a great degree, the future of both military and civil aircraft depends on the completion of the NASP Program. Economically NASP makes sense. Dollars and cents. The U.S. positive balance of trade in aerospace products was $18.7 billion. That is larger than any other industrial sector. Much of the U.S. technology's lead is the result of long-term high-risk research such as is underway in a NASP Program.

All Americans benefit from a strong economy and aerospace products are leading the way globally.

I look forward today to hearing from the witnesses on what the NASP Program should be. I have my own opinion of what it should be. And I want to hear from each witness why we cannot have a X-30 flying in 1996.

Thank you, Mr. Chairman.

Mr. **Dellums**. I thank the gentleman for his opening statement.

Are there any other brief opening remarks?

The Chair would recognize my distinguished colleague, member of the Subcommittee on Research and Development, Mr. McCurdy.

Mr. **McCurdy**. Mr. Chairman, thank you. And I will make my comments brief.

The Chairman knows and has heard my statements throughout the markup of the Research and Development's Subcommittee's mark in Armed Services and also the full committee, and as a member of both the subcommittees and having chaired the Science Subcommittee, I wanted to just briefly make a comment about the statements today and the testimony.

I commend the chairman for continuing these joint hearings. I think it is a demonstration of Congressional support for this program. I quite honestly have been very disappointed in the Space Council's decision. I always thought that Space Councils were supposed to aim high.

In the Secretary's statement on page 2, I found the statement that I hope he will, at least in words and his actions, make it sound more impressive in the printed page and looks, and that is the first line on the second paragraph says, "The stretched program remains a high priority." It is almost like one of the oxymorons, military intelligence or something. "A stretched program remains a high priority."

To me that is a symbol of some of the problems that we face today. We on the Armed Services Committee remember when Secretary Lehman appeared before the Committee on the B-2 and he said, "We are fully supportive of it." And then they backed out of the program. And that is why we have had difficulty sustaining the program.

I want to hear today, and I think we all do, how much the Air Force is committed to this program, how much in the future you intend to fund it, and how we are putting this in concrete or in the strongest emphasis. This is a lukewarm endorsement at best and I think the Space Council's appeared to be that way. And I for one, who authored the amendment to increase the funding in the Armed Services Committee, feel that the administration can do a lot better. We in Congress have demonstrated our support for it. We want to remain competitive. We believe this has applications both militarily and civilian and want to see the support coming from the administration.

And I yield back my time.

Mr. **Dellums**. The gentleman yields back his time. And I thank him for his opening remarks.

Mr. Secretary, Mr. Truly, we would like to welcome both of you before the Joint Subcommittees this morning. And we are in receipt of your written testimony.

Without objection, the full text of your prepared remarks will appear at the appropriate point in the record and you may proceed in any fashion you choose, Mr. Secretary.

STATEMENT OF HON. DONALD B. RICE, SECRETARY, U.S. AIR FORCE

Secretary RICE. Mr. Chairman, and members of the subcommittees, thank you for hearing our thoughts on the National Aero-Space Plane Program. One that we certainly agree with you is a high-priority national effort.

For both the Air Force and NASA, this is an important, perhaps to say, critical stage in the program. Since as you have been noting, President Bush recently approved a rephasing based on a National Space Council review of NASP.

The Air Force joins NASA in fully supporting the President's policy.

I'd like to read you a short excerpt from it.

> The United States will continue the NASP Program as a high-priority national effort to develop and demonstrate hyper-sonic technologies with the ultimate goal of single-stage to orbit. The Government will plan to develop an experimental flight vehicle after completion of phase two if technically feasible. Performance of the experimental flight vehicle will be constrained to the minimum necessary to meet the highest priority research as opposed to operational objectives.

The President's goal is clearly to minimize technical and cost uncertainly associated with the experimental vehicle by having the current phase focus only on research and technology objectives.

This program and its funding profiles sharpen our ability to assess risk and they allow needed time for technology development, time for data analysis, and time for assessment and decision on options for the X-vehicle design. They also, of course, respond to fiscal realities.

The Joint DOD/NASA Management Structure remains as does the aggressive nature of our research into air-breathing propulsion materials, advanced aero-dynamics, fuel system performance, and advanced avionics and other areas that are relevant here.

Hypersonics research is a very high priority for the country and the recent changes to the time line and funding of the research program I believe will reinforce our efforts to pursue the National Aero-Space Plane at an appropriate pace.

With that short opening comment, let me turn to Admiral Truly who has some additional comments he would like to make and then we will both be happy to respond to your questions.

[The prepared statement of Hon. Rice follows:]

The Honorable Donald B. Rice
Secretary of the Air Force
Statement before the
Subcommittee on Transportation, Aviation and Materials
Committee on Science, Space and Technology
and the
Subcommittee on Research and Development
Committee on Armed Services
House of Representatives
August 2, 1989

Mr. Chairmen and members of the Subcommittees, I appreciate the opportunity to join NASA in reviewing for you the National Aerospace Plane Program. As you know, based on a National Space Council review, the President has recently approved a redefined program. In response to his decision, we will continue the NASP program as a high priority national effort to develop and demonstrate hypersonic technologies with the ultimate goal of single-stage-to-orbit. The Air Force fully supports President Bush's decision. It aggressively pursues the technical challenges of hypersonic flight while preserving a prudent balance between risk and cost.

The National Space Council's review of NASP and President Bush's decision to improve the phasing of the program have placed the near-term focus on high priority research, as opposed to operational, objectives. We project completion of the technology development phase for 1993. At that point we plan to begin developing the flight research vehicle if feasible. Successful results from the X-vehicle would permit consideration of full scale development of operational military and civilian systems.

The budget will be amended to reflect the pure technology focus of NASP, and to reflect fiscal realities. This fall DoD will add $27 Million to the $100 Million already planned for FY90. To continue the program requires a DoD total of $158 Million in FY91 and $233 Million in FY92. DoD's refined budget estimates for the Five Year Defense Plan will be submitted along with the FY91 budget.

The stretched program remains a high priority national program managed by the joint DoD-NASA structure. Hypersonics and its enabling technologies are essential development efforts to future operating options. Hypersonic flight is the next logical step in mastering aerospace.

DoD, NASA and our partners in industry have invested in high-payoff technologies and test facilities. To date we've gleaned some excellent data from thousands of hours of wind tunnel tests and supercomputer analyses. Much more remains to be done.

The new program and funding profiles sharpen our ability to assess risk and allow time for technology development. A measured and prudent pace is critical since the NASP will be the most highly integrated vehicle ever attempted. For instance, in layman's terms, the engine would be the entire underside of the airplane. For required performance the entire NASP vehicle needs to be optimized, not just individual engine or airframe components. If anything changes on the vehicle lines, it affects both engine and airframe performance. This level of integration is unprecedented.

MATERIALS AND ENGINES: PROGRESS AND CHALLENGES

Well before design stages, pure technology research also poses unprecedented challenges. Two critical NASP technologies illustrate: materials that will withstand the hypersonic temperature environment and engines that will provide thrust to achieve orbital velocities.

The NASP Joint Program Office, in directing the unique industry Materials Consortium, is leading development of five major materials areas--materials that can take high temperatures and that are strong and lightweight. The challenges are significant, but progress has been made--notably with titanium alloys. Plain titanium can withstand about 1100 degrees Fahrenheit, and is used in today's airplanes. The NASP program is working on titanium alloys and titanium composites (a combination of high-strength fibers and titanium alloys) with more strength and stiffness. These composites will have to withstand up to 1800 degrees Fahrenheit.

Another focus of materials research is refractory composites, like carbon-carbon. Other vehicles, like the shuttle, use carbon-carbon for heat protection, but the NASP requires greater oxidation resistance for more reusability and less repair and replacement.

The program has made progress in developing the materials. The hurdle ahead is to form large structures of the size needed for airframes. We must refine capabilities to weld, drill and otherwise join the materials into meaningful structures. The program's rephasing raises the level of confidence in building these large components.

Perhaps more importantly, it also gives us time to look at production of these structures from a manufacturing standpoint. Decision-makers will know if we can produce structures from new materials at low cost before deciding to proceed with Phase III. The restructure gave added emphasis to producibility and manufacturing technology.

In the engine area, the NASP Joint Program Office with the assistance of the Air Force Propulsion Lab, NASA Langley, NASA Lewis, Ames, Johns Hopkins University, Rocketdyne and Pratt & Whitney, among many others, are also working on subscale engines and components of full scale engines. After building, running and data collecting since 1985, we're meeting performance expectations in tests. For example, Scramjet engine tests are showing combustion efficiencies of better than 95% at Mach 8 and below. Those results are a credit to the program; however, much more work needs to be done.

The NASP program revision provides necessary time to build complete engines at full scale for testing. To have done that in one year would have required going directly from component tests to flight-type cooled engine tests. Improving the phasing gives us the option of going to an engine that may not have flight cooling or flight weight characteristics as a first step, then to one that does.

The reason for singling out materials and propulsion is that about 80% of NASP funding goes into those two areas. We've come a long way, but more time in Phase II will enhance technological readiness and let us better understand risk.

X-VEHICLE

After completing the NASP research phase and after understanding what technology will allow in terms of capability and cost, we'll be able to evaluate the feasibility of an X-vehicle. To that end, we'll continue to look at vehicles that will demonstrate capabilities for single stage to orbit. But technology goals and costs cannot yet be estimated for high fidelity definition of a flight vehicle--especially one that will be a flying wind tunnel.

Today's ground facilities can test up to 8 times the speed of sound for full scale engines. If we enter Phase III of the NASP program, the bulk of the engine data we possess will have been generated in the regime of Mach 0 to 8.

The X-vehicle will have to do in the air what we can't simulate on the ground, both in terms of engine performance and aerodynamic conditions in the uncharted hypersonic regime. The improved phasing of the NASP program will increase the chances for the X-vehicle's success--and the likelihood of success for follow-on systems.

CONCLUSION

It's essential that the United States remain the leader in developing and exploiting hypersonic technology. The recent changes in the NASP research program will strengthen our efforts. The program that has emerged from the National Space Council's review is sound, sensible, and led by a DoD-NASA-industry partnership that includes some of the nation's finest minds, technical support and test facilities. DoD and NASA join the members of these committees in wanting the National Aerospace Plane Program to succeed. We believe the President's direction charts the course for success.

Thank you, Mr Chairmen.

Mr. **Dellums**. Thank you very much.

Please proceed, Admiral Truly.

STATEMENT OF ADM. RICHARD H. TRULY, ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Admiral **Truly**. Thank you, Mr. Chairman.

I am very pleased to join Secretary Rice here to testify with him on the National Aero-Space Plane Program.

I think we are seeing a national resurgence because of the NASP Program and hypersonic R&D in this country and that goes from NASA and military laboratories to our industry and right down into university graduate education and research programs.

The program has undergone a recent and very intense review, first in NASA, and in the Department of Defense, then at the National Space Council, which made a recommendation which was approved by President Bush. And I believe that this program now is on a strong track and best balances the overall risk and affordability and also the achievability of the National Aero-Space Plane Program.

I and NASA fully support the President's decision. I think it is essential that America remain a leader in hypersonic technology and I believe this program remains a vigorous and a viable program.

Its goal continues to be single-stage-to-orbit vehicle with a focus on a research vehicle that will prove that early on. It will deal with research and technology issues first.

And as Secretary Rice mentioned, it will maintain its feature as a national program with a joint DOD and NASA management of it. NASA's strong support for NASP frankly is based on the promise and the benefits when the program is successful. It will provide improved man-access-to-orbit in the next century. It will provide operational flexibility and low costs and rapid access that is unachievable today. And furthermore, the exciting technologies that this program will provide will certainly find their way into other Defense and NASA programs and I believe into the private sector in the future.

NASA's contribution to this program remains strong and it is across the board in propulsion, in airframes, in materials and structures, and in flight research planning. We provide a strong part of our institutional base, about 300 NASA people and NASA laboratories and NASA wind tunnels and NASA capable high-speed computers to the success of the program.

In summary, I fully support the National Aero-Space Plane. NASA is making a major contribution to it in dollars and people and in national facilities and we look forward to continuing to do that.

We are a full partner in the program, and I believe that the intensive review that we have given to the program on both sides of the river and in the National Space Council make me feel like the program is frankly stronger than it has ever been in the past.

Thank you, Mr. Chairman.

[The prepared statement of Admiral Truly follows:]

STATEMENT
OF
RICHARD H. TRULY
Administrator

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

before the

Subcommittee on Transportation, Aviation and Materials
Committee on Science, Space and Technology

and the

Subcommittee on Research and Development
Committee on Armed Services

House of Representatives

Mr. Chairmen and Members of the Subcommittees:

I am pleased to join with my DOD colleagues for the third annual hearing before these Subcommittees to review the planning and the progress for the DOD/NASA National Aero-Space Plane (NASP) program. During my presentation, I will present NASA's FY 1990 Transatmospheric Research and Technology (R&T) budget request, which provides NASA funding support as a partner in this important national program, and describe NASA's overall contributions to the program.

As you are well aware, the NASP program has undergone an intense review by the National Space Council. NASA was an active participant in the process and fully supports the President's decision to redefine the focus of NASP to pursue a classic x-vehicle in a manner that best balances overall risk and affordability.

Since the inception of the program, NASA has been and in the future will remain, a strong supporter of the program. It is essential that America be the leader in hypersonic technology and its application. In order to maintain our current leadership position, we must have a vigorous and viable NASP program, one with the features that are outlined in the President's decision. These features include focusing on an experimental flight vehicle, concentrating on research and technology objectives as opposed to operational ones, extending the technology development phase of the program approximately 2 1/2 years and maintaining an appropriate joint NASA/DOD management structure.

Although the program has been making good progress and testing and analysis is proceeding at an accelerating pace, it is necessary to extend the duration of Phase II by 2 1/2 years. This stretch will allow additional time for technology development and maturation and will significantly reduce the risk of not achieving the program goals. The extension is not excessive. The program that we now have is still extremely aggressive but it is one that can be done.

NASA's strong support for NASP is a direct reflection of the many benefits we expect the program to produce. First and foremost among these is the capability to provide improved manned access to earth orbit. A horizontal take-off and landing airbreathing vehicle based on NASP technologies holds the potential to provide flexible, relatively low cost and rapid access to space to enhance our overall space transportation infrastructure. Second, the exciting technologies which are being made available by the program will have a far-reaching impact in many NASA and DOD programs and will surely find their way to the private sector to improve our competitive posture. Our partnership with the DOD in experimental aircraft design and flight testing is built on a long history of successful joint programs and is in the spirit of NASA's charter role in aeronautics.

The NASA budget request for transatmospheric R&T for FY 1990 is $127M, the number agreed to in the NASP MOU. These funds are needed to provide the necessary efforts in the engine and airframe areas, in technology maturation and, through the materials consortium, in new material development.

The four major elements of the NASP program are the engine contracts, the airframe contracts, the materials and structures consortium, and the technology maturation effort. It is in the technology maturation area that the government laboratories, particularly the NASA Research Centers, have major activities. We continue to support the program with people and facilities. About 300 technical and administrative NASA people are working on the program at the NASA centers, at the Joint Program Office at the NASP Inter-Agency Office. NASA also has an office in OAST to oversee our participation in the program. Throughout this past year the technology maturation effort has made important contributions in the areas of propulsion, computational fluid dynamics, aerothermodynamics, advanced materials, and flight research planning.

In the propulsion area, research at the Langley Research Center has provided improved understanding of the physical processes in the inlet, combustion chamber and nozzle of the scramjet engine, which is required for propelling the X-30 from Mach 4 to near-orbital speed. At the Lewis Research Center, tests have been completed on a large-scale inlet model and efforts continue on evaluating the potential of slush hydrogen as an X-30 fuel. Advanced computational fluid dynamics (CFD) codes, developed at NASA Ames and NASA Langley, which predict aerodynamics and physical flow effects at hypersonic flight conditions, have been released to the NASP contractors for use in their engine and configuration development.

Significant progress is being made in the critical area of advanced materials and structures. Central to the materials and structures effort is the unique consortium of the five NASP engine and airframe contractors who are working closely to accelerate the development of the needed materials. Important research is being conducted in characterizing candidate materials such as metal matrix composites, carbon-carbon, and ceramics and evaluation is underway of carbon-carbon coatings needed for survival of some of the materials in the severe X-30 flight environment.

Flight research and test planning is continuing, utilizing simulations of NASP vehicle characteristics based upon CFD predictions from the Numerical Aerodynamic Simulator (NAS) and data from tests in NASA wind tunnels. Approaches to the expansion of the X-30 flight envelope, cockpit displays, off-design operation of systems, and other facets of flight test are being evaluated by simulation techniques to establish a safe means to conduct the flight program and to ensure that the critical aerodynamic, propulsion, structures, and systems data will be acquired.

Wind tunnels, large computer systems, and other unique test facilities at the NASA Research Centers and other government and industrial laboratories are being used to support the very vigorous test and analysis programs of both the contractor and the technology maturation efforts. Rocketdyne has conducted successful tests of a one-seventh scale model of their engine in the Langley Research Center's scramjet facility. General Dynamics and Rockwell conducted tests at the Naval Weapons Systems Command to verify the performance of their inlet design. These tests, the direct connect combustor tests by Pratt & Whitney at Marquardt, and results from other engine test facilities provided by the NASP program, have provided much data for the scramjet engine concepts. Data from wind tunnel tests have also provided calibration of advanced CFD codes for use by the engine and airframe contractors. McDonnell-Douglas has evaluated candidate structural configurations under thermal loads using test facilities at NASA Ames-Dryden. Rockwell has conducted aerodynamic tests to determine stability derivative effects on their configuration in their own Trisonic Tunnel and at the Arnold Engineering Development Center.

NASA has committed time on the powerful Class VI computers at each of the Research Centers to support NASP analyses and design activities. NASA personnel supporting this program used this capability in the downselect of contractors in 1987, and they supported the engine Test Module Review (TMR) in April 1989. These large computer systems, along with those of the contractors, have been linked by satellite to the NAS at the Ames Research Center to give the program ready access to the world's most powerful aerodynamic computer system.

In the face of emerging hypersonic vehicle programs in Europe and Japan, the United States continues as the leader in hypersonic research and is uniquely positioned to exploit advances in propulsion, materials and structures, computational sciences, and controls technologies for future aerospace vehicle applications. The NASP program which has emerged from the Space Council review is stronger than before and will strengthen our position in hypersonics. NASA is proud to be a partner with the DOD and to commit our technical expertise, management skills, and unique national facilities toward the success of this effort.

Thank you, Mr. Chairmen.

Mr. **Dellums**. I thank both gentlemen for their opening remarks. And the Chair would just like to begin the questioning before I yield to Mr. Valentine for such time as he may consume.

First, as the Chair understands it, the Space Council has recommended a 2½-year stretchout in the development, of the development phase of this program. But we have not received any quantitative set of technical milestones which the Defense Science Board specifically said was lacking from the program.

Against the backdrop of those remarks, I ask two questions. First, what is the basis for the 2½-year stretchout? What is the basis for the 2½-year slip?

Secretary **Rice**. Mr. Chairman, at this point that is grounded in the results of the reviews that Admiral Truly just was referring to and both of us have been involved in. And it represents a best judgment at this point about the time that is required to go through the remaining stages of technology development and closure. Technology characterization in some cases, if you will. Time for the testing, the data analysis to be done that results from that technology work. And the testing that can be done. And time for the design alternatives to be worked through and seriously considered, and a measured and appropriate decision to be made about the choice of an X-vehicle.

And all of those matters, in our view, are simply going to take longer, even as part and expressly as part of an aggressive technology program. All of those matters are simply going to take longer than had been allowed for in the schedule that we inherited.

Mr. **Dellums**. Admiral, let me comment from a slightly different vantage point and ask you the following question.

Is this an issue of not being able to get a funding commitment on the one hand or are you confronting technical problems with this program on the other hand?

Admiral **Truly**. In the reviews that I held within NASA, which included not only our headquarters people that were in charge of the program, but also the Center Directors of all three of our Research Centers. That is the Ames Research Center, the Lewis Research Center and Langley Research Center. The unanimous view was that the program, despite funding availabilities, needed some more maturing time in order to be able to make a reasoned decision on an X-vehicle that would be achievable and the schedule that we were on was optimistic.

So the combination of the budget reviews and these technical reviews ended up with an agreed-to approach between the DOD and NASA, and we went together to the Space Council in agreement. And the end result was, as Secretary Rice said, was the schedule that you have before you.

Mr. **Dellums**. Thank you very much.

Your testimony indicates that you are requesting an fiscal year 1990 $127 million for NASA and the Air Force program. Because of the diligence of the distinguished gentleman from Oklahoma, Mr. McCurdy, the House bill contains a figure of $285 million. We plan to go to conference several weeks from now.

Let us say that that $285 million holds in conference. For what purpose would you use the different amount of monies, the difference between $127 million that you requested and the $285 million that the gentleman from Oklahoma believes is an appropriate level of funding for this program?

Secretary RICE. That mark, I believe, Mr. Chairman, is for the Air Force portion of the program. And we have not at this point tried to lay out a program to utilize that level of funding.

Mr. DELLUMS. You are saying that the $127 million is just for the Air Force.

Secretary RICE. Excuse me, sir. I believe the $127 is just for the Air Force and there is a separate $127 requested for NASA.

Mr. DELLUMS. I see.

Secretary RICE. For a total of $254 million for the total program in fiscal year 1990.

The mark that you were referring to I believe was to increase the Air Force portion of the program. And that, of course, would change the balance of participation in the program dramatically from what has been worked out within the Administration.

We have not attempted to lay out a program that would utilize that higher level of funding at this point. We believe we have a sound program at the levels that were requested and we have them programmed in our internal planning to rise over the next couple of years, leading up to the X-vehicle.

Mr. DELLUMS. All right. So the request is for $127 million for NASA, $127 million for the Air Force?

Secretary RICE. Yes, sir.

Mr. DELLUMS. That is the portion of the budget that we on the Research and Development, the Armed Services Committee, deal with. So you are saying that your request is for $127 million and that you really do not need this additional funds above that request for the Air Force program, because the gentleman from Oklahoma has requested $285 million for the Air Force program.

Secretary RICE. Mr. Chairman, just to be sure that we have got all the details straight. There was only $100 million included in the President's Budget for the Air Force portion of this program.

Mr. DELLUMS. Right.

Secretary RICE. And that request was associated with a decision at that point in time to stand-down the DOD and Air Force's participation in this program, and that $100 million was considered to be transition funding as the remainder of the program transitioned back to NASA.

In the deliberations within the Administration, the planning within the Air Force, and jointly with NASA, we arrived at the program plan which we believe is a prudent and sensible and appropriate one that calls for $127 million from each Agency for fiscal year 1990. That $27 million increment we have been assuming we would need to find, as a reprogramming action, within the overall DOD funds. Obviously action by the Congress could change the way in which those funds are actually arrived at for the fiscal year 1990 program.

Mr. McCURDY. Would the Chairman yield just on the point.

Mr. DELLUMS. I'd be happy to yield to the gentleman.

Mr. McCURDY. To set the record straight, the Reagan Administration had requested $300 million which was the original request. The Bush bogies that came forward basically took $200 million out and submitted $100 million in the Air Force budget which basically was the transfer determination. The Air Force said, "We do not want it anymore." The Air Force lost its aim.

We in this committee originally added $200 million in our Research and Development Subcommittee with the support of the Chairman to the full funding level, $300 million, for the Reagan request. The gentleman from Alabama, the ranking Republican on this committee, asked for $15 million of that $200 million for other programs. I acceded to his request and that is where the $285 million came forward.

The original $100 million of the Bush numbers were pending a decision by the Space Council. Most of us have assumed that the Space Council would have recommended closer to the original numbers, that is why we plussed up the account. It did not do so. So in fact there is $158 million lying in this mark, the Committee's bill, that has passed the House, above the Space Council's request.

So I think what the gentleman was just asking you is are you saying that the Congress in conference should reduce the amount in the budget to the $127 million, or should we keep that money available in support of the program?

Secretary RICE. Our recommendation would be, Mr. McCurdy, that the Congress complete its action at the $127 level if it elects to adjust the funding from what was proposed in the President's Budget rather than leave it to a reprogramming action later.

Mr. DELLUMS. I thank the gentleman. The gentleman did accurately state the history and I appreciate the Secretary's response.

The Chair will now recognize Mr. Valentine for such time as the gentleman may consume.

Mr. VALENTINE. Thank you, Mr. Chairman.

I would like to make a brief comment then ask the first question I guess of Mr. Rice.

Some of us here and at other places in the Congress believe that the most powerful weapon that the military can develop is technical muscle. And we believe that the X-1 through the X-15 programs literally gave the country the muscle to build the Air Force as it now exists. The X-30's sole product in our opinion is technical muscle for a new Air Force. And I would like to know, Mr. Rice, if you think that is a correct statement?

Secretary RICE. Mr. Valentine, I would try to say it in even stronger words if I could.

This area of technology is the lifeblood, it is the future, of the Air Force in many ways. I feel certainly from a personal point of view I can certainly attest to you that the Air Force is in fact strongly committed to this program area, to this technology area, and to this program as we now have it laid out.

I certainly very much agree with you and I think it is a widespread view within the Air Force that advancing these areas of technology is critical to our future. And not just to the future of military capabilities, but to the broader future of the technology base and all that that means to the economic well-being of the country. And we certainly have those needs and priorities very much in mind here as we are working on this program.

And I would like to try to emphasize that while I believe we are in full agreement on objectives, and this discussion is entirely about prudent means to reach the same objectives, it is not a discussion that has a difference in objectives at all in my view.

You have mentioned that the earlier X-vehicles were focused on research objectives and I would just like to emphasize that that is now in this adjusted program precisely the view that is being adopted as we look forward to the X-30.

I think it would be a fair comment that before these recent reviews, there had been allowed to creep into the program considerations of operational objectives or requirements that may have been influencing some of the technology work and some of the design considerations leading towards an X-vehicle choice.

And as part of this review and as part of the decisions made within the administration, and in fact, embodied in the President's Directive, is very clear guidance that operational considerations, operational missions, are not to be drivers in the design of this vehicle. It is to be this program and the design of the X-vehicle is to be focused around research and technology objectives, and those are not to be added to or distorted in any way by the imposition of operational considerations. That is, considerations of future operational capabilities.

So I believe that the program as it is now laid out is in fact designed very much in accord with the principles that you were just suggesting.

Mr. VALENTINE. Mr. Rice, did the Air Force not object to the program because it was not a weapons systems currently?

Secretary RICE. I am sorry, Mr. Valentine. You mean this current program?

Mr. VALENTINE. Yes.

Secretary RICE. Quite the contrary, sir. The Air Force is strongly supportive of the need to pursue and pursue vigorously these important areas of technology because of their long-term importance.

There is I believe a concern that arises in all of our minds that sometimes short-run needs are allowed to crowd out those activities that are important for the longer-term health of not just the Air Force but the broader technology base.

I believe in this case a quite appropriate balanced conclusion has been made on that matter and the emphasis has been put on seeing to it that we take care of the long term, which I take to be precisely the objective that is behind the comments that I have heard from all of you this morning.

Mr. McCURDY. Would the gentleman yield on that point?

Mr. VALENTINE. I yield.

Mr. McCURDY. Mr. Secretary, you were not appointed at the time that the Secretary of Defense appeared before this full Committee, the Armed Services Committee.

But I recall in his testimony and I recall that the press surrounding the initial decision of the Bush administration to descope or even terminate the Air Force's decision to terminate the NASP Program was primarily because they did not understand—they could not see a military mission for this technology.

Now, that was the original justification that they brought forward to us for the cancellation. I was one who was arguing that quite frankly we could foresee not only military but intelligence and other capabilities in the out years. Although we, this committee, wanted the emphasis to be on a research platform.

Now the Air Force, and again I guess we are B.C. and A.D. here, but now the Air Force is saying that you truly want to have a research program. We commend you for that, but that is not consistent with the earlier decision, and I think what we are trying to pull out of you today, and we have not been very successful up to this point, is what is the depth of your support? Is the support consistent through the Air Force and DOD? Is Mr. Chu, has he bought off on this proposal? And are you consistently going to support a research program which quite frankly should be shorter term than putting on your bells and whistles on it and making it an operational objective?

Secretary **RICE**. I will try to state it again, Mr. McCurdy.

The Air Force's support is strong and vigorous for this program. We believe it is essential to the long-term health of the Air Force as well as to the long-term health of the technology base in this country.

The decision has not just been made—the decision we are describing—has not just been taken within the Air Force. It has been made at the level of the Secretary of Defense. The Deputy Secretary Atwood was personally very deeply involved in the reviews that we have been referring to. And has personally approved and carried forward in the Space Council deliberations, the results of those reviews, and I can certainly tell you that he is fully in support of this program as well.

And I would simply like to emphasize that what we are talking about here is a question of judgment about the time that is required to make our way through all of the near inventing that has to be done to have the time to characterize and understand the results of that process, to translate the results of that process into the design options for an X-vehicle, recognizing that that X-vehicle is to be dedicated to only research and technology objectives, and then to make a sensible choice about that X-vehicle and its particular design.

And I do not see any of that as being inconsistent with or contrary to the objectives that I hear all of the members here espousing this morning. Quite the contrary, I think we share the same objectives, and as I have said earlier, we are only discussing the most realistic means to achieve those objectives. We are not arguing about objectives at all in my view.

Mr. **VALENTINE**. What does a new schedule mean insofar as a phase three is concerned? And can you give us a new projected flight date?

Secretary **RICE**. No, sir. We can give you the projected closure dates on phase two at this point, but the specific first flight date can only be derived from the choice of the design and the decisions that have to be made in terms of what is involved in actually constructing the X-vehicle that results from this process.

And I think frankly that anyone who tries to tell you today they know when that X-vehicle will fly is making a judgment I would say is questionable as to whether anyone can make. We are still dealing with such uncertainties in the technology that the actual physical size of the X-vehicle is uncertain over quite a wide range.

And circumstances of that great uncertainty still in this technology closure process, there simply is not any way to pin a fixed date on the flight.

What we can do is pin the schedule, as we have done, to when we expect it to be possible to make a decision, a considered and sensible and informed decision, on that X-vehicle, and at that time we will certainly be able to tell you what the appropriate construction and flight schedule for it would be.

Mr. VALENTINE. Mr. Chairman——

Secretary RICE. I understand Mr. Truly would like to add something to that.

Mr. VALENTINE. Yes.

Admiral TRULY. No, I think that is exactly the way that I would look at it also. You know, this vehicle is going to be constructed of materials that have not been invented yet. It is going to have a propulsion system that is going to operate in a flight regime that it is impossible to test on the ground. I think it would be very imprudent to sit here and project a flight date when the thing that we need to do, and I think as the Secretary said, I think we are in intense agreement as to what we need to do first and that is to complete this phase two technology program and definition so we can make a flight vehicle decision. And the only question is what is the prudent pace at which that can be done.

Mr. VALENTINE. Well, Mr. Chairman, I am almost finished. I do not want to hog the time and I am sure other members will return to some of these questions.

Let me just say what a colleague, Dave McCurdy, said in a different way. I guess what we are trying to find out is whether or not this is true love or just another shotgun wedding.

And in that connection, let me ask you, Admiral, we are going to have a space station I suppose. Do we really—and this goes to whether we really need this technology or not—but do you really have a plan for servicing a space station to get up there and back when we want to go and do what has to be done? Do we really have any way to handle that without a NASP-derived vehicle?

Admiral TRULY. Well, as a matter of fact, a Space Station will become operational in the mid-1990's and for the first ten to fifteen years of its life it will be serviced by the Space Shuttle. The Space Shuttle, in my view, is going to need replacing probably around the year 2005 to 2010. I believe that the National Aero-Space Plane technologies on the schedule that we are recommending will, if developed and if demonstrated in the experimental vehicle, would be extremely competitive to follow on to the shuttle to support a Space Station.

I would like to make one other comment, if I might, to your remark, and that is as to the implication as to how NASA and the DOD came to this. Let me just say that we did have an intensive review first in the two agencies and in my case it was entirely within NASA. But then early in that I had a conversation with Secretary Cheney and it was shortly after he had come to the full committee, and I expressed the desire at that time that I was hopeful that by the time we did get to the Space Council on this issue that we would be together.

Subsequently, at the appropriate time I did meet with Secretary Rice and Deputy Secretary of Defense Atwood on this very subject and we had independently come to the conclusion that the pace of this objective that I think we are in agreement on was proper with our recommendations.

So I feel very confident certainly on the NASA side and in my view of those conversations on the DOD side that you have two agencies that are together and are fully supportive to move ahead. And the question again is the pace. And we think our proposed pace is proper and achievable.

Mr. **Dellums**. Does that conclude the gentleman's questions? The gentleman yields back his time.

Mr. Secretary, let me just ask you one question before I yield to Mr. Lewis. At this particular time and this phase, is the Air Force the appropriate place for this program or should this program be in DARPA at this point?

Secretary **Rice**. Mr. Chairman, I think the Air Force is the appropriate place, but let me characterize the place for you.

What we are talking about is a joint program office. That is the way the program has been carried out. It has a program director who is an Air Force senior civilian scientist, a NASA Deputy Director. There are in fact Navy representatives in the program office as well. We are in the process now of working together with NASA to review and make certain that we have that program management arrangement as strong as we can make it. We are looking at ways to make sure that the relevant players in the Air Force and in NASA who are responsible for many of the technology areas that have to be worked on and brought together here are involved and supportive of the program.

So I think we've got a sound core of a basis for a management approach and it is one that we are continuing to review as we sit here and intend to make sure it is as strong as we can make it.

Mr. **Dellums**. I thank you, gentlemen.

The Chair would now recognize Mr. Lewis for such time as the gentleman may consume.

Mr. **Lewis**. Thank you, Mr. Chairman.

I have several questions, Mr. Chairman. Are we going to have time after the vote to——

Mr. **Dellums**. If the Chair understands, this is a controversial vote to approve the journal and if it is the wish of the committee, we would recess for 10 minutes and come back, if the gentleman would prefer that.

Mr. **Lewis**. I would prefer to do that, Mr. Chairman.

Mrs. **Byron**. Mr. Chairman, I have one quick short question I think if I could get it in before the recess.

Mr. **Dellums**. The Chair would recognize the gentlewoman from Maryland, a member of the Subcommittee on Research and Development.

Mrs. **Byron**. Mr. Secretary, let me ask you. We are right now in phase two of a joint DOD/NASA program. It is basically the reversal of Mr. McCurdy's question.

There is language in our bill this year that if NASA at the time frame of phase three decides not to continue in this arena, is the Air Force committed enough to this program to go ahead? I am one that feels that we get up to the brink so often in programs where the technology breakthroughs have come about and then many people say because of the cost, we cannot move forward. But as we all know, the initial costs are in those technology breakthroughs. And so I am one that feels that when we get up to those brinks the commitment and decision must be, as hard as it is, is one that the Air Force is going to have to face.

Secretary RICE. Well, as I have emphasized, the Air Force is strongly committed to this program. As we have also tried to explain, we believe that the schedule that is now laid out is the appropriate one on which to try to come to a decision about the X-vehicle.

I would personally not like that outcome to be one in which the Air Force and NASA parted company at that point. Let us remember what we are talking about here. If you think of this in DOD system development terms, this is a pre-milestone zero-technology program.

We have begun describing the X-vehicle as a flying wind tunnel to try to emphasize some of the very kinds of points that members of the committees have been calling out here this morning. This is exploration and development of areas of technology that will have critical applications in both NASA and Air Force programs and systems down the line as well as, we all expect, valuable spinoffs to commercial systems.

So to my mind, or my way of thinking, it certainly should not turn out to be something that prior to completion of the X-vehicle program itself, that the Air Force and NASA should part company on.

Mrs. BYRON. I guess what really concerns me is that we put together teams working on very exciting new innovative programs and then we do not fund them so they can get their work done.

Thank you, Mr. Chairman.

Secretary RICE. I would just add, Mrs. Byron, that I think the level of excitement in Air Force and NASA from my experience in this short few months of dealing with this is high as well. And I think there is strong commitment to this program and the expectation is we are going to go through it together.

We do expect that the relative funding mix will change over time. Right now we believe that 50/50 breakdown that is proposed in the program for fiscal year 1990 is entirely appropriate given that the early stages of technology development across a range of technologies that the program still embodies. We do anticipate as the program goes forward that the funding burden will shift relatively more heavily to the DOD and Air Force budget.

Mr. DELLUMS. At this point the Joint Hearing will recess for 10 minutes and upon return we will proceed with the gentleman from Florida, Mr. Lewis, for such time as he may consume.

[Recess.]

Mr. DELLUMS. The subcommittee will resume its business.

The Chair recognizes the gentleman from Florida, Mr. Lewis, for such time as he may consume.

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. Secretary and Mr. Truly, you both were discussing and asked the questions and gave some answers on the stretch-out of the X-30 program. I would like to know or have you tell the subcommittee for the record just what are the technology risks that are leading to stretching phase 2 for 2½ years? No one seemed to be concerned about that last year. And if those risks are there this year, they were there last year.

Mr. Truly, would you like to comment on that please?

Admiral TRULY. Well, I hate to speak to last year because personally all of my personal opinions about the program have come from reviews that have been made on today's status and within the last couple or three months.

I would characterize on the previous schedule—anytime that you do a new program, you have a choice in the various parts of the program as to whether to be conservative or optimistic in your judgment as to what schedule you should be on. In a program like this, there are many areas that are really leading edge technology in materials development and research, manufacturing capabilities, engine performance, the choices of propellants, whether slush hydrogen or liquid hydrogen, et cetera, et cetera.

In my assessment of the program, on the previous schedule, every one of the schedule assessments, was on the very optimistic side. And when I integrated that and listened to it, it seemed to me that it was that more than anything that it seemed to me to be unrealistic on that schedule.

There are things that can be done in the additional time that are very real that will provide the decision to make the X-vehicle a much more sound one. There are wind tunnel facilities that are not going to be available in the next year that will be available in the next 2 to 2½ years.

There will be time to do some large structural testing of some of the large structural components or test rigs of those so the program will have that data.

So when I added it all up, the objectives were the same, but I felt that as the budget discussions were held, the technology side of the schedule argument should also have been taken into account. And I came to find out that these exact sorts of assessments were being held in the Pentagon at the same time and when we did get together, we were pretty much in agreement as to the time that it would take.

Mr. LEWIS. Admiral Truly, did you come to this conclusion after the Science Council's decision or before? Or did you recommend it to them?

Admiral TRULY. The Space Council decision?

Mr. LEWIS. Yes.

Admiral TRULY. The assessments that we made were made in the interim between the initial budget decision that Secretary Cheney made and at that time I had just become the Acting Administrator almost simultaneously with that. And the internal reviews that I held were between that time and prior to the Space Council meeting.

Mr. LEWIS. Mr. Secretary, what is the Air Force's concerns about technological risk in propulsion, systems integration, and materials research?

Secretary RICE. Mr. Lewis, I would just echo what Administrator Truly has said across the board.

Mr. **Lewis**. Are you going to give me the risks, Mr. Secretary, or just repeat what he said?

Secretary **Rice**. I am sorry, sir?

Mr. **Lewis**. Are you going to give me the risks in propulsion, system integration, and materials or are you going to repeat what Admiral Truly said? I asked you what the risks are, these technological risks in these areas.

Secretary **Rice**. I am going to try and address the subjects you have raised, sir. But I wanted to begin first by emphasizing that the issue does not come down in my mind to one of the specifics that can be cited in any one or two or three particular technology areas.

As Administrator Truly has emphasized, the problem is one of integration across a wide range of technologies, each one of which has to be advanced in order to get to the point where our knowledge base is secure to contribute from that area to the design of the X-vehicle.

You asked about risks in propulsion. We have many areas that are not fully understood there. The SCRAM jet engine does not literally exist today, as you know, for the full range—to operate over the full range of the regime that is called for here.

I have seen it described that it is literally the case that the whole underside of the vehicle, in the kind of vehicle we are going to be talking about here, is the engine. That means that the engine airframe integration problem is much more complex in the kind of vehicle that is being contemplated here than it is in even the most advanced aircraft that we have built in the past. That is another example of the integration kind of——

Mr. **Lewis**. Mr. Secretary, if I can interrupt you at that point. Was this not common knowledge when we started the technology for the Aero-Space Plane? The SCRAM jet we know quite a bit about. We are not talking about this airplane taking off in 1994 or 1995 and flying the full range of its envelope. We are talking about possibly getting it off the ground to see if we can circle the patch of land after you take the steps in these technologies.

So it just does not seem to me that you are stretching out two and a half years just because you say we have an integrated technology that cannot meet the full envelope.

Secretary **Rice**. All I think we can tell you, Mr. Lewis, is that based on judgments that came together between DOD and NASA after independent reviews in each agency which as Administrator Truly has emphasized came to strikingly similar views and conclusions about the assessment of the program and the amount of effort and time that was going to be required to be able to make a considered and informed decision on the X-vehicle design. After those reviews, we had come to quite similar conclusions about the effort that was still before us.

Were these factors that we have been talking about known about in a conceptual sense? Of course they were. From much earlier stages of the program.

Now, all we can do is report to you the results of the reviews that we have conducted in recent times and I would go a step beyond that and say to you that in my judgment we are in an area here, as I tried to emphasize earlier, where you simply cannot order it up on a schedule. Again, this is pre-milestone zero technology development. There is a great deal of inventing going on here. The inventing has to go on. Tests have to be done. Data have to be collected. All that has to be integrated. Alternative design concepts have to be explored. And then finally a decision has to be made about that.

And as I look at where this program is today, and look forward on a schedule that we are now talking about, I do not see the slightest thing unreasonable about the length of time we are talking about. In fact, I would frankly still see this as an ambitious program that we are engaged in here.

Mr. LEWIS. Well, Mr. Secretary, could you supply the committees with copies of your assessments, and the Air Force assessments, in these particular areas of propulsion, materials, and systems integration that you based your decision on?

Secretary RICE. We can provide you materials for the record, yes, sir.

[The material referred to follows:]

Item	Title
1	Point Paper on the Pace of Development for Phase II of the National Aero-Space Plane (NASP) Program, prepared by Science and Technology Directorate, Office of the Assistant Secretary of the Air Force (Acquisition) (SAF/AQT), 18 Jun 1989
2	NASP Technology Status, prepared by NASP Joint Program Office (JPO), 19 May 1989

POINT PAPER

ON

THE PACE OF DEVELOPMENT FOR PHASE II OF THE NASP PROGRAM

Inherent risk of Phase III.

The attached chart shows the pace of aircraft development since 1900 with aircraft speed as a function of time. Clearly, making the jump from the Mach 3-6 vehicles of the 1960's to the Mach 25 needed for SSTO involves significant risk. This is especially significant in light of the fact that US wind tunnel test capability for long duration, large scale engine testing only extends to Mach 8. The risk of Phase III would also be significantly increased if the X-30 were a prototype vice an x-vehicle, an approach that some believe was underway. The major technical challenges of Phase III are:

Propulsion.

Demonstrate and gather data on the operation of an airbreathing ramjet/scramjet engine integrated into a flight research vehicle. This demonstration includes the transit from ramjet to scramjet mode and envelope expansion up to orbital velocity (Mach 25), if possible -- an eight-fold increase in speed over the most advanced current airbreathing engines. For example, at Mach 20, fuel injection, mixing and combustion must occur in less than one millisecond.

Materials.

Prove the ability of advanced high-strength, lightweight, reusable materials such as titanium metal matrix composites to operate from extremely low temperatures to the very high temperatures generated by hypersonic flight in the atmosphere, an increase of approximately 75% in strength to weight

SAF/AQT/57866/18 Jun 89

at high tempreatures over materials in use today. The heat flux (BTU/sec/ft^2) encountered at the leading edges will be approximately four times that of the SR-71. This results in the need for advanced materials such as reusable carbon-carbon which would not require any refurbishment or replacement during the flight test period.

Structures.

Fabricate advanced materials into a flight research vehicle structure which has a significantly higher fuel fraction (approximately .70) than current aircraft. In simple terms, building a large aircraft designed for the aerodynamic loads associated with SSTO with the materials mentioned above is a significant challenge. For example, structural cooling requirements for the engine cowl leading edge are approximately three orders of magnitude greater than any previously experienced in a reusable flight vehicle. Active cooling will be required to dissipate these heat loads.

Flight Controls.

Demonstrate *for the first time*, a fully integrated vehicle management system with three axis control for heating, aerodynamic and propulsion which has sufficient precision to meet the attitude and trajectory requirements for hypersonic flight. Also, this will be a significant software challenge.

Fuels.

Demonstrate the ability to, in a routine manner, manufacture, handle, store, pipe AND PUMP liquid and, for the first time, slush hydrogen.

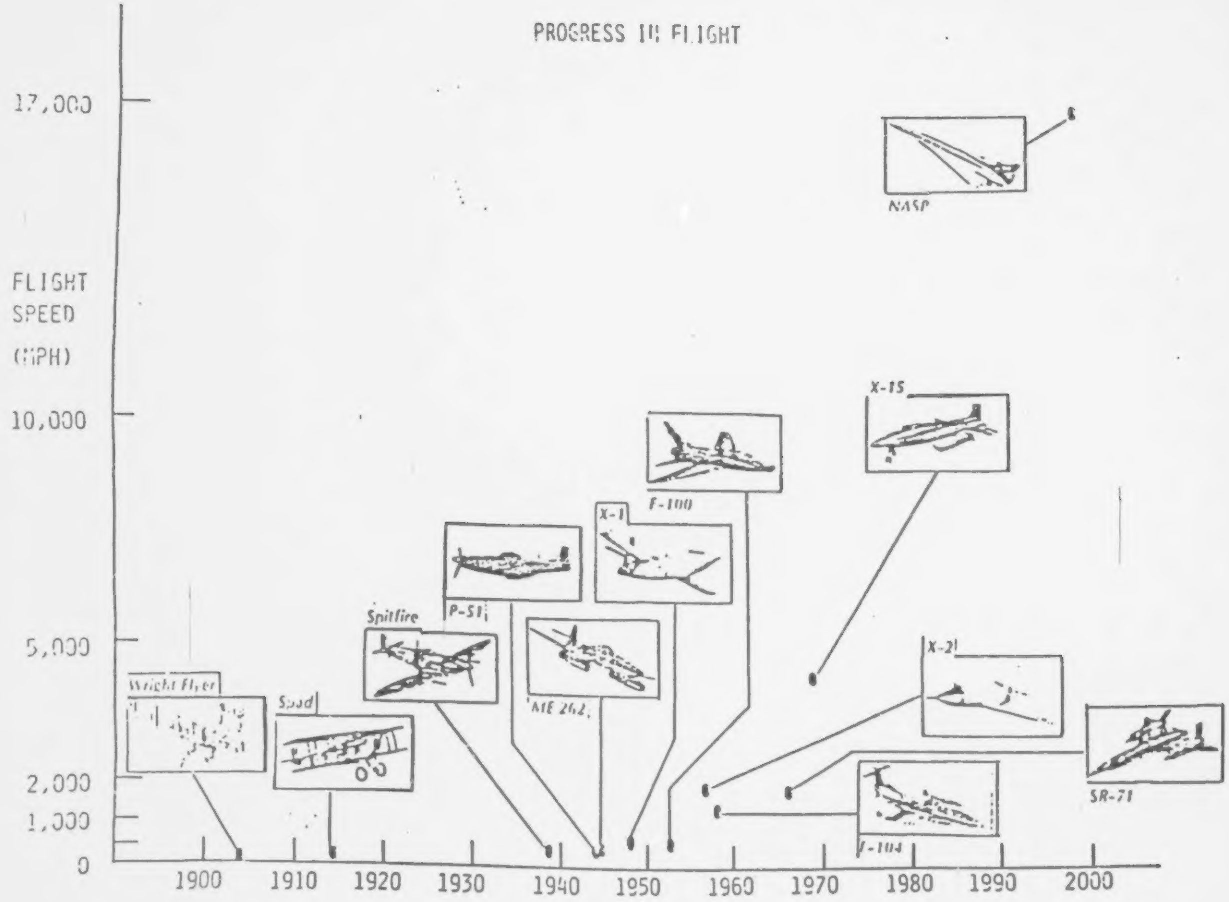
Probability of Successful Risk Closure in Phase II.

Good program planning requires a judgement as to the amount of time to allow for successful risk closure. Given that significant technology development must be accomplished independently and simultaneously in the areas of propulsion, materials, fuels, structures, flight controls, and other critical technologies, the application of an equivalent amount of resources over a longer period tends to reduce risk because of the additional time allowed for the synergism and interaction between the principal areas of risk. Simply stated, given equal resources, more time allows for an integrated assessment of risk.

Resources available.

Another consideration is that more time allows the program to take greater advantage of in-house NASA support capabilities which are available at no cost to the program.

These three factors - taken together have led the senior leadership in DoD and the Air Force to favor a prudent extension of Phase II as essential to a high quality decision on the appropriate content and cost of Phase III.



PROGRESS IN FLIGHT

NASP Technology Status

Airbreathing Propulsion

Materials

Advanced Aerodynamics

Fuel System Performance

Advanced Avionics

-----

prepared by
NASP Joint Program Office
19 May 1989

Airbreathing Propulsion

Progress in airbreathing propulsion has resulted principally from efforts of Pratt & Whitney and Rocketdyne, coupled to extensive broad-based technology development at several government laboratories.

At the beginning of the NASP Program, several ramjet development programs, most notably at NASA Langley, Johns Hopkins Applied Physics Laboratory, and Marquardt, had demonstrated subscale ramjet engine operation in shock tunnels and small wind tunnels to Mach numbers of five to six. Using this as a baseline, the NASP program modified two major large-scale engine facilities to enable steady-state testing to Mach 8, modified several arc-heated propulsion experimental facilities to extend their range, and developed a number of key shock tunnel combustion rigs to simulate Mach 8-24 flow for propulsion component tests. These facilities are now operational and are currently being utilized to investigate over two dozen ramjet/scramjet engine systems and subsystems developed by the expanded industrial/government NASP propulsion team.

There are over 1000 people in the United States involved in hypersonic propulsion development and the understanding and development of ramjet and scramjet engines for NASP experimental vehicles is progressing on schedule.

Large-scale engine subsystems have been tested to Mach 7 and propulsion performance has approached the original expectations. CFD analysis of mixing, combustion and engine performance is on schedule and can now be used to predict experimental-sized engine performance. Thousands of data points have been obtained at velocities from M=2 to M-20. Low speed systems have been constructed and tested to required performance. Two large-scale engine modules are under construction and will be tested to Mach 8.

The technical and cost risk of the program are addressed in specific contractor risk reduction programs. Each analysis and test reduces the overall program risk. Tests on NASP produced hardware have demonstrated scramjet feasibility and produced combustion efficiency levels approaching predictions. Multiple-fuel injection concepts have been shown to work. Wind tunnel tests have demonstrated specific design provisions to enhance operability and experimentally verify that consequences of flow instability are far less than initially predicted. Hardware and materials demonstrations are confirming the ability to use actively-cooled engine panels for thermal survival and to improve ductility and hydrogen resistance of materials desired for use in the engine flow path. Fallback positions on materials include those with similar strength and density, but with a lesser temperature capability. These would require the use of more active cooling flow. The second fallback position would be available super alloys with desired temperature capability, but higher weight. To deal with uncertainty in component thermodynamic efficiency, the contractors have examined judicious use of backup rocket power in selected regions of the single-stage-to-orbit trajectory.

In summary, the program now has significant experimental and analytical data which indicates the feasibility and performance of propulsion systems necessary for the attainment of the NASP X-30 program goals.

Materials

Materials are the key to the successful development of hypersonic and aerospace vehicles, yet they pose the greatest technical challenge of the program. Early progress of the critical structural and propulsion materials was insufficient to meet the NASP schedule and a major change in NASP materials development was necessary. Since the formulation and funding of the Materials Consortium, the development and demonstration of high temperature, high strength materials has been significantly accelerated and is now consistent with the developmental requirements of the NASP Program.

Although the high temperature materials technology of the 60s and 70s was the encouragement for the initiation of the NASP Program, material requirements for the X-30 clearly exceeded the state-of-the-art in 1985. Early NASP materials work centered on the development of exotic alloys, metal-matrix composites and refractory composites. Although some capability was achieved with small test articles, a significantly enhanced materials program was recommended by the 1987 Defense Science Board study. Two major breakthroughs were required. Five fundamental categories of materials needed to be developed, characterized, fabricated, scaled and manufactured in the several years remaining in the program. Secondly, the transition and utilization of this materials technology by the engine and airframe contractors had to be accelerated by a factor of two from normal practice. This was accomplished by increasing the investment in materials development to approximately $50M/year and forming the Materials Consortium to allow collaboration and rapid application of the materials development by the system developers.

Progress in Titanium Aluminides, Titanium Aluminide Composites, Coated Carbon-Carbon, add high conductivity, high temperature engine materials has been significant. Materials required for X-30 fabrication have been produced and are now being characterized and developed for subsystem fabrication. Titanium aluminide structures have been built and tested to vehicle operating conditions and oxidation-resistant carbon-carbon has been produced and thermally cycled to required X-30 capability. In addition, more advanced materials and components have been fabricated and tested, which provide the basis for assessing that materials development will be sufficient at the end of Phase 2 to allow the initiation of the X-30 program.

The risk in the material area manifests itself as either increases in vehicle weight or increased on-aircraft maintenance if 100 percent of the life requirement for thermal protection materials such as carbon-carbon is not achieved by the time the X-30 long-lead dates for materials purchase arrive. The weight risk could be in the form of carrying increased coolant to maintain a fallback material at a lower operating temperature. Another manifestation, depending on the particular configuration, would be to fallback to a material with higher density. An estimate for one of the current vehicle configurations to switch the primary material would involve a vehicle takeoff gross weight penalty of approximately 10 percent, presuming no change in structural design criteria. It is possible that the weight penalty could be lessened in this scenario by altering criteria, since in some cases the NASP criteria are 7 percent more demanding than the Space Shuttle.

Advanced Aerodynamics

Advances in aerodynamics have been rooted in an extensive amount of wind tunnel tests of inlets, nozzles, and complete aircraft models as well as major progress in the ability of computational fluid dynamics to accurately predict the very complex characteristics of hypersonic flow.

In 1985, the government baseline model was the only aircraft design that had accumulated any significant design analysis. At this stage of the program, over 100 NASP configurations have been designed and developed,, over twenty-five of these configuration have received extensive wind tunnel testing, and we now have the ability to develop very detailed aerodynamic configurations using 3-D Navier Stokes CFD codes which incorporate turbulence, combustion, and real gas effects within several days. While the CFD capability is the key to truly understanding the aerodynamics of the X-30, over 20,000 minutes of arc-heated, combustion-heated, and shock heated wind tunnel tests have been obtained. Inlet kinetic energy efficiencies and nozzle thrust coefficients in the 95-99% range, which are required for acceptable NASP operation, have been demonstrated. Inlet unstart and its effect on vehicle performance is now understood and consequences are less severe than expected. Aircraft stability and control is currently under extensive study and major advances in aerodynamic performance over the past two years have led to significant reductions in the TOGW of the Phase 3 X-30 vehicles.

Experimental and analytical (computational fluid dynamics) validation has occurred and will continue for the key aerodynamic areas, namely drag, aircraft stability and control, and aero heating. Risk associated with drag uncertainty is comparatively low (a 10 percent error in drag corresponds to about a 5 percent vehicle takeoff weight penalty) and that associated with stability and control is little different than the Space Shuttle which has clearly demonstrated vehicle controllability over the NASP speed range. Devices to address aero heating hot spots such as nose, wing, and engine leading edges, have already been built and will be tested by the end of Phase 2C to continually increasing levels of severity. This activity will include a multiplicity in devices and test facilities.

The ability to design vehicles with predictable engine inlet conditions while maintaining acceptable aerodynamic performance is now in hand. As configuration focusing occurs over the next year, very accurate and detailed analysis of the aerodynamic performance of the vehicle(s) will be possible using CFD. All indicators are that aerodynamic performance will achieve that necessary for acceptable X-30 vehicle capabilities.

Fuel System Performance

The work in NASP fuel systems has focused on (1) the feasibility of using liquid hydrogen as the baseline NASP fuel, (2) the utilization of the liquid hydrogen as structural coolant, (3) the efficient cryogenic containment of the fuel in the X-30 vehicle, and (4) the potential of slush hydrogen fuel to enhance vehicle performance.

The technology base of using liquid hydrogen as a space vehicle fuel was well established at the beginning of the NASP Program. Its extension to aerospace vehicles has been experimentally and analytically verified and cryogenic tanks to contain the fuel in the X-30 have been constructed/tested, and characterized. Fabrication techniques are now well understood and acceptable cryogenic system performance is virtually assured.

The use of liquid hydrogen to actively cool the high temperature, high heat flux sections of the vehicle is now under careful experimental study using full scale components and realistic test conditions. Available data indicates that this approach is both feasible and enhancing to vehicle performance.

The primary uncertainty regarding fuel system performance will be to assume, by program need dates, that the ability to use slush hydrogen has been confirmed. The effort to make this determination has been established and is underway. The ability to transfer slush to the aircraft and maintain its desired thermodynamic properties on board are the key questions in its technical viability. Given the industrial base for handling an assortment of cryogenic materials (which yields technical confidence) and the fact that the X-30 vehicle does not need slush until preparation for its single-stage-to-orbit mission (which provides schedule flexibility) the main risk entails ensuring proper cost estimates to accommodate slush development. Every attempt is being made to include consideration of all relevant factors in these estimates, including the development of slush, compatibility testing between slush and handling equipment, and off-aircraft support hardware and facilities.

Analysis has indicated that 15-20% reductions in TOGW are possible if slush hydrogen can be substituted for liquid hydrogen. In order to investigate slush feasibility, a major facility to produce, store, pump and transfer slush hydrogen has been fabricated and operated. Early results indicate that slush handling is manageable and its application to NASP vehicles should be viewed as an engineering development task (as opposed to technology development) that can be completely consistent with the X-30 schedule.

Advanced Avionics

Since Phase 3 of the NASP Program will be limited to the development and flight testing of an experimental demonstration vehicle, avionics development has been aimed primarily at crew systems integration, aircraft and engine control technologies, and flight vehicle management systems.

The requirements for aerospace plane crew, control, and flight management systems can be obtained from extrapolations of Mach 3-5 aircraft data and analysis as well as current space transportation system experience. Although early studies indicated the need for major breakthroughs in flight control and management systems, the NASP design analysis conducted during the past year has shown that a reasonable extension of current flight vehicle capability should suffice for the X-30. Architecture for flight and propulsion control systems have been defined and capitalized on recent industry experience with high performance fighter aircraft, i.e., digital multi-channel control, integrated propulsion and flight control, software development, etc. Software codes have been sized and are no larger than the newest fighter aircraft. Development of control systems, software technology, and overall vehicle management approaches that will meet the needs of Phase 3 is well underway.

A major activity in crew systems development has been underway since the beginning of the program. In all areas, contractors have established requirements and are working to demonstrate compliance with them. Flight testing of direct vision systems to solve the external visibility matter with the NASP vehicles streamlined nose has already been successfully completed and flight testing is now in progress on an indirect (TV-type) system. Four full-capability simulators have been developed and are in operation at this time. These simulators and their operation over the past two years are giving the government and industrial teams the data needed for the X-30 crew system design.

Structural analysis have been done to define vehicle nose deflections under combined loads. These results indicate that coupling between structures, controls, and propulsion is manageable through existing engineering development approaches.

In addition to the crew station activity, several programs are underway to develop appropriate visibility approaches, display systems, high speed landing gear and tires for the X-30. Logistic and supportability studies have been conducted from the very onset of the program and a major subsystems consortium activity is now in place to develop instrumentation and air data systems for the Phase 3 program.

Mr. **Lewis**. OK. Just one offhanded comment.

As you are aware, when we went to the moon the technologies did not exist to put us on the moon when the program was instigated and conceived. And we had to work our way to get there. And I guess your enthusiasm for this program just overwhelms me and it just does not seem to be there that we are all of a sudden ever so cautious which seems to me we are looking for making a funding decision and looking for a way to justify it quite frankly.

I would like to——

Secretary **Rice**. Mr. Lewis, if I could comment on that.

Mr. **Lewis**. You certainly can, Mr. Secretary.

Secretary **Rice**. I really cannot accept the implications of that commentary.

Mr. **Lewis**. Well, then, first of all explain to the committee why $200 million was left off.

Secretary **Rice**. I came into office to take this position in circumstances in which the decision that was extant in the Defense Department at the time was that the DOD was going to step out of this program. And I certainly came in with the personal conviction that this area of technology was critical to the future of the Air Force and DOD and that we should not step out of it. And I took it on as my mission to review this area and to formulate what I believe would be an appropriate and defensible success-oriented sustainable program for Air Force and DOD to stay in this area.

And that is what we brought forward in conjunction with NASA to the Space Council. And so my reading of this recent history would be a little different than I think the implications of your comment.

I would like to emphasize again. I believe we share the same objectives. And I do not think you can force feed the kind of thing that we are trying to accomplish here. The amount of time we are talking about is not at all unreasonable or unrealistic and it still represents an aggressive program in these very difficult technology areas.

Mr. **Lewis**. Well, there may be some substantiation to what you say, Mr. Secretary, but it just seems rather unusual to me that we go from one group of scientists and technologists in one administration that funds sufficiently a program and these same technological questions existed at that time, I am sure, and some of the same people, and then we switch 6 or 8 months later and say, "We have got a too hard to do job here. We are going to have to cut it back." It just does not make good sense, and particularly after the edict was put out that the DOD budget must be cut by a substantial amount and this becomes one of the fall programs for those cuts. That is the reason for my comment.

Secretary **Rice**. Mr. Lewis, on the subject of scientific reviews, I have looked at three reviews that have been done by eminent panels of scientists over the years, over the last several years. One by a Defense Science Board Group. One by a National Research Council Group. One by an Air Force Scientific Advisory Board Group. And my reading of all of them would be that the counsel that one should get from them is that this program had to become more prudent than the basis it was actually operating on at the time those reviews were done.

So I think there is quite a lot of scientific background and review background and I know there have been reviews done at NASA as well in which outside scientists have been involved as well as those within the agency. And I read those activities as supportive of the program definition that we are bringing before you. And not the other way around.

Mr. LEWIS. Well, it just seems hard to accept. You know, we have a program that is moving ahead. And we have the industry outside almost matching the program dollar for dollar. Risking their dollars as well. And we get into a number of programs which is another ball game that we asked industry to do the same thing and then cut them off. So I will get off that.

Mr. Chairman, I just have a few more questions——

Mr. DELLUMS. The Chair would just like to let my colleagues know that because of other scheduling, we will have to be out of this room by one. We have two additional panels. It would be the hope of the Chair that we could continue to move through so that we would preclude the need for an afternoon session.

I did not want in any way retard my colleagues' enthusiasm, but I just wanted to admonish my colleagues that we are under some time constraints and the gentleman still has the time.

Mr. LEWIS. Well, just one further question then, Mr. Chairman. I thank you for your indulgence.

Mr. Secretary, you asked the Rand Corporation to review the NASP Program and it did so without any participation of the NASP industry teams.

Is this an accurate rendition?

Secretary RICE. No, sir. It is not accurate that I asked the Rand Corporation to do anything. I believe that under one of its tasks for the Air Force there was a review being carried out that began quite some time ago, during the time I was still at Rand. I had very little to do with it then. I have had informal conversations with two of the scientists who have been involved in that review, along with many other discussions and examinations of these scientific advisory group reviews that I referred to a moment ago. So there certainly has not been any commissioning of a Rand effort on my part to look at this program.

Mr. LEWIS. OK.

Thank you, Mr. Chairman, and thank you, Mr. Secretary and Admiral Truly.

I have a number of other questions, Mr. Chairman, that I would like to submit in writing for a response from the witnesses to the committee.

Mr. DELLUMS. I would appreciate that. And the Chair would indicate to my colleague that depending on how the questions go, if time remains I would more than pleased to yield back to the gentleman so that he may conclude his questions.

The gentleman from Pennsylvania, Mr. Walker, is recognized for such time as he may consume.

Mr. WALKER. Thank you, Mr. Chairman.

I think it is important we get the history straight here as to how we arrived at the decision. Because I am hearing a number of different things here that bother me a little bit.

I think everybody has represented the situation as it exists but I don't think we have a complete picture.

When NASA went to the Space Council on June 27th, the June 27th meeting, had your reviews been completed at that time, Admiral Truly?

Admiral TRULY. I just do not remember. Was June 27th the day that the Vice President convened the Space Council on this issue?

Mr. WALKER. That is right. That is my understanding, yes.

Admiral TRULY. If in fact that was——

Mr. WALKER. It was a working group meeting, I am sorry.

Admiral TRULY. That was the perk meeting prior to the Space Council—Mr. Walker, I am told that the formal Space Council meeting was 3 days later on the 30th. And on the 27th there was a working group meeting.

Mr. WALKER. The working group meeting was the 27th. That is exactly right.

Admiral TRULY. Yes. And as of the time of that working group meeting, all of my personal participation in reviews, all the briefings that I had heard, had been concluded. After the Policy Implementation and Review Center (PIRC) meeting on the 27th, if that is the correct date, I believe I did go over to the Pentagon and meet with Secretary Rice and Secretary Atwood in preparation for the Space Council meeting. But frankly, that was a get together and there was no technical review held.

Mr. WALKER. But the internal reviews within NASA had been completed by June 27th?

Admiral TRULY. Yes, to my knowledge they had.

Mr. WALKER. Am I correct, that at the June 27th working group meeting NASA's recommendation, based upon technical considerations, was that a 1-year stretch be implemented in the program?

Admiral TRULY. I do not believe that that is the case, Mr. Walker.

Mr. WALKER. Well, did at that point you recommend a 2½-year stretch?

Admiral TRULY. I did not attend that meeting. Just a moment, sir. Mr. Walker, I am told by Mr. Rosen, who is the Associate Administrator for the Office of Aeronautics and Space Technology, that at the PIRC meeting NASA supported the Air Force's position at that meeting which was eventually the program that was dealt with three days later which represented a 2½-year slip to the program. I was not at the meeting, however, but that is consistent with my recollection.

Mr. WALKER. You supported the Air Force's position? So you were in support of Air Force position and your reviews had in fact brought you to that conclusion before you discussed this with Air Force?

Admiral TRULY. I think so.

Mr. WALKER. Well, let me ask you this.

Admiral TRULY. My recollection is that all the reviews that I held and participated in led me to the belief that a stretch-out of the program was definitely in order.

Mr. WALKER. I am not debating that.

Admiral TRULY. OK.

Mr. Walker. But my understanding is that the stretch-out that NASA proposed as a result of its reviews was a 1-year stretch, not a 2½-year stretch. And that in fact the original working group paper, back in May 16th, which I have here, in fact put that in writing and recommends a 1-year stretch.

What we are a little confused by is how we ended up getting an extra 1½-year stretchout of a program where the reviews evidently indicated that there was some need for a stretch, but certainly not 2½ years. And how a working draft of the Space Council recommended a 1-year stretch. That got expanded to a 2½-year stretch. That is what I am coming down—I want to make certain the history is clear here. Not that a stretch was recommended. Everybody agrees that that was done. The question is the time of the stretch.

Admiral Truly. Well, let me just say one more thing. Any paper that was dated May the 15th, I had not completed by internal reviews, and so any proposal at that time, it may well be on NASA stationary, but it did not involve my review of the subject on May 15th.

Mr. Walker. Was the Program Manager within NASA involved in the reviews?

Admiral Truly. Yes.

Mr. Walker. What puzzles us, at least me and I think a few others, is I have also a copy here of this Rand Corporation Working Draft. It appears as though the stretch that we have come up ties in almost precisely with the recommendations of the Rand Corporation as to what this program should become, and that this Rand Corporation document is very anti NASP.

Now, you know, we are a little disturbed about that. And I am particularly disturbed, I must say, Mr. Rice, when I hear you suggest as a part of the questioning here this morning that if Congress comes up with extra money, you intend to reprogram it.

Now, you know, that I think that the extra money may be there. I have talked to Mr. Murtha, of the Appropriations Committee. He is aggressive about this program. The Authorizing Committees are aggressive about the program. I think we are going to end up with the full funding in the appropriation out of the Appropriations Subcommittee based upon what Mr. Traxler has represented is going to go on in the conference. We are likely to give you somewhere in the vicinity of $400 million for this program. And it will have us precisely on track of where we think we ought to be based upon previous commitments.

And what I hear you saying as a part of an aggressive program is, "Well, if you give us that much money, we are going to reprogram some of it."

That does not sound to me like a program that is moving vigorously forward. And I am disturbed because really this document suggests that we move it from a manned program to an unmanned program. And when I hear suggestions that we are not even going to fly it until the late nineties or that we cannot even come up with a schedule for flying it, it indicates to me that somewhere along the line someone may decide that the Rand Corporation was right again, and that we ought to go to unmanned.

Does somebody want to reply to this? I mean was this document taken at all into account when the decision was made by the National Space Council?

Secretary RICE. I cannot tell you about that, Mr. Walker. I have not read that document that you have in your hand.

Let me back up a minute on some comments I made earlier.

Mr. WALKER. You have never read this document?

Admiral Truly, have you ever read the document?

Admiral TRULY. No.

Mr. WALKER. Was this document discussed at the Space Council?

Secretary RICE. Not to my knowledge.

Admiral TRULY. I only attended one meeting at the Space Council on this subject and this document, to my recollection, was not discussed at the Council meeting.

Mr. WALKER. Mr. Rice, you indicated that you had talked to some people at the Rand Corporation, scientists that were involved. Were those scientists Bruno Augenstein and Elwyn Harris? Are those the scientists that you spoke with?

Secretary RICE. My recollection is that most of my discussion was with Dr. George Donohue and Dr. Augenstein may also have been involved. I do not remember Dr. Harris being involved.

Mr. WALKER. OK. So you did talk to Dr. Augenstein who is one of the preparers of this report. So you have not read the report but you are certainly familiar with the content of it.

Secretary RICE. I talked to Dr. Donohue.

Mr. WALKER. You did not talk to Dr. Augenstein?

Secretary RICE. My memory is simply unclear whether Dr. Augenstein was in the discussion or not. I very vividly recall that most of my discussion of the subject was with Dr. Donohue. Dr. Augenstein may also have been in the room.

Mr. WALKER. May have been? Would you supply for the record, that information for us please?

Secretary RICE. Sure.

[The information follows:]

Answer. My discussion of the subject was with Dr. Donohue and Dr. Augenstein.

Mr. WALKER. And also whether or not——

Secretary RICE. Let me back up on one other thing though, Mr. Walker. I did not say that additional funds would be reprogrammed. My comment about reprogramming before was that it had been the Air Force's and the Department of Defense's plan to reprogram the additional $27 million that our NASP Program calls for from within the total funds the Congress provides for the Air Force in fiscal year 1990 and that plan would be necessary if the Congress were to agree with the amount that was requested in the amended President's Budget, in President Bush's Budget, which called for only $100 million.

Beyond that, I said in answer I believe to the Chairman's question that my recommendation would be that the Congress provide $127 million for the program. I did not comment about reprogramming or anything else with respect to additional amounts if they are to be provided.

I would only add the thought that again you cannot force feed this process. We may be able to spend more money, but I am not prepared to sit here and tell you that if we do, the decision point will come appreciably sooner at which we can make an informed judgment about an X-vehicle.

Mr. **Walker**. Are you familiar with a memorandum dated May 5th to you from a Jim Bonomo with regard to the national aerospace plane? With copies to Bruno Augenstein, B. Bradley, G. Donohue, E. Harris, and Jim Thomson, in which the matter of aerospace plane is raised?

Secretary **Rice**. I am familiar with, no. Do I remember that there was such a document? Yes.

Mr. **Walker**. And this document also makes the point that Augenstein and Harris describe the lack of a compelling mission for NASP-derived systems? Are you familiar with that portion of the memorandum?

Secretary **Rice**. I do not remember that portion of the memorandum, but the point is not relevant to what we are talking about. Operational missions, whether or not they were well defined or not well defined, they were creeping into the definition of this program prior to this point, and it is very clear in the President's guidance and in the program definition we have now that operational missions are not a part of what we are talking about for this program.

Mr. **Walker**. No. But the reason why this memorandum is important is because it goes on and it says, "This suggests—" it talks about their recommendation. And then it says, "This suggests—" and I am quoting. "This suggests an alternative slower and smaller program that does not require a manned single-staged orbit vehicle."

Some of us suspect that that is what we got out of the National Space Council. So some of us suspect that this memorandum tied to the Rand working document is exactly where we are headed and do not think that that is a sufficient program.

Secretary **Rice**. Mr. Walker, all I can tell you is that neither of us sitting here at this table think that is where we are headed.

Mr. **Walker**. That is encouraging.

Thank you, Mr. Chairman.

Mr. **Dellums**. The gentleman yields back his time.

The Chair now recognizes the gentleman from Oklahoma, Mr. McCurdy, for such time as he may consume.

Mr. **McCurdy**. Thank you, Mr. Chairman.

Well, I appreciate the gentleman from Pennsylvania's line of questioning regarding the Rand study because that has been out there and I hope that we have clarified some of those concerns.

The study's conclusion in this June 1989 study basically said, regarding NASP utility and applications, that they saw no compelling quote, "Golden mission" end quote existing for NASP, and that they were competitors and counterparts for important NASP missions. And, of course, this Rand study was prepared for the Air Force and that is why some of us are a little disturbed by the findings.

And we want to make sure that there is a consistent position here.

Secretary **Rice**. Mr. McCurdy, if I could. Just one more comment on that.

I believe that that work was done—I did not follow it closely when I was still at Rand. I believe that work was done in the context of the very movement that we have been arguing against here I think on both sides of this table, in the context of this kind of creeping operationalism, if you will, into the program.

I would also say to you for the record here that the scientists who are involved in that review and whose names have been cited here today are outstanding scientists and very highly competent in the areas they work in. But I think probably that review that to be put in the context that I was just alluding to.

Mr. McCurdy. Well, obviously they were coming to a conclusion that we do not support. And we feel that those who are concerned about maintaining America's preeminence in aeronautics certainly do not support. And clearly if you are just budgeting within the Air Force, you can arrive at those conclusions.

But this is not just an Air Force program. And it is not just a NASA program. It is a national program and we have had two presidents back to back maintain the position, and as a matter of fact, on the record, I took issue with my party's nominee, Mr. Dukakis, in the forum on the question of NASP because he had said he opposed it and I took him to issue. And George Bush came out and said he was in favor of NASP.

So, you know, I am siding with the Republicans on this issue and I think it should not be a Republican or Democratic issue. It is a national issue. It is not just NASA. It is not just Air Force. This is something that is critical for all of us. And that is what we are hitting on.

Now, Mr. Valentine made a very pithy statement. He said that he wanted to find out whether this was a shotgun wedding or a marriage of love. And I would only have one addendum to that. And that is whether it was a shotgun wedding or a marriage of love, the family has decided to put off having babies. It is a question of appropriation. You have decided to put it off. And to me that is what is disturbing here.

We want to have a system that is operational. We want a test vehicle. We want an X-30 out there and believe that this is important for the country. And we are just hoping that you are not putting it off too long.

One statement made earlier that I questioned was—the Admiral made the comment that so much of this technology has to be invented. I am not so sure it is a question of inventing or selection. And Jim Moore and I had a little discussion between votes regarding of the materials issues, and being on the Materials Subcommittee I have looked at some of this and believe there is a unique teaming arrangement to look at the material aspects and, for instance, the carbon carbon technology. Some people said, "Well, it is not mature." Well, you know and I know that the nose cone on the shuttle is carbon carbon. And it has never been replaced. I mean you do not replace it like you do the tiles. I mean it is there. It is stable.

These are the kinds of things we would like to see advanced and moved on. So I am not sure—you know, we have got a whole table full of media folks over there and they are going to go out and print this stuff. And the last thing we want is the headlines to say that NASP is delayed because we have not invented the systems yet. I do not think that is accurate.

Secretary RICE. If I might comment to that. I would not argue with a different way of saying it because certainly there are—we are very far along on the materials work and in some cases I think probably there will be new materials that we will select and therefore they have not been invented. But certainly you could say that a careful selection process is another way to say that. And I would not argue with that.

I would argue that that careful selection process to choose those materials for a very large vehicle will be on a more prudent basis on the new schedule than it was had we had to make that decision in the year 1998.

You can pour money on the problem and I still think you want an achievable program. That is what we all want.

Mr. MCCURDY. I will not take issue on that. But I wanted to be clear that we are talking selection here. We are not going out and say we are going to develop a brandnew material that is not even on the drawing board here. We are talking about a range of materials that are within the base of knowledge that we have out there today.

Secretary RICE. Certainly within the technology——

Mr. MCCURDY. Now, we may have difficulty manufacturing or getting to the scale necessary, but that is the technical challenge. That is why we are doing it. If you do not push it, it remains in the laboratory. We are trying to get it out of the laboratory into flight.

Mr. Chairman, I am anxious to hear the next panel of witnesses, so I am going to thank the gentlemen. I hope that they understand from this meeting that the level of concern that Congress has and that we feel that we have carried a heavy burden in a time of fiscal austerity in budget cuts to be able—when the Chairman of this subcommittee, Mr. Dellums, who has been as tough on us this year on dollars as you can ever imagine, and offering major cuts to allow an amendment, and support an amendment, to increase funding, I think that is a pretty strong signal.

And I will say this, Mr. Chairman. In the conference, because you and I will both be conferees, the $158 million, if you say you are not going to have it, I have a few ideas of places it can go and probably will not be in the Air Force. It will probably be spent elsewhere and I think that is a shame that we had to come to that point but so be it.

Mr. DELLUMS. The gentleman yields back his time.

The Chair might indicate to my good friend, one of the attractive reasons for the amendment was it did come out of SDI. [Laughter.]

Let me just ask one final question of you gentlemen, because I tried to listen very carefully.

I'm sorry? My distinguished colleague from California, Mr. Rohrabacher, I recognize for such time as he may consume.

Mr. ROHRABACHER. Being the only other Congressman on this panel with a beard, I am very appreciative of that remembrance.

I would like to ask just a couple of questions and I will keep it short.

First of all, Secretary Rice, are you surprised at the skepticism that you are being met with today? I mean you have mentioned in glowing words the excitement in the Air Force about this project and there seems to be skepticism about that description. Are you surprised by our reaction?

Secretary RICE. No. I am a slow learner, Mr. Rohrabacher, but I am learning to be not surprised by much of anything anymore.

To take your point seriously, I understand I believe quite fully where the members are coming from with these questions. This is, as I think we have all been stating and restating here, this is a critical national program. These areas of technology matter to many parts of our way of life, not just to Defense or NASA programs. And there has been a level of expectation which has had to be modified. And so I understand that.

Mr. ROHRABACHER. But there are people who doubt that people in the Air Force—there are those of us, I should say, who doubt there are people in the Air Force who really believe that this is a critical program.

Let me ask you very pointedly. Do you operate under the assumption that NASP is a program aimed at research and development and experimentation or is NASP a program aimed at building an experimental manned vehicle that will fly?

Secretary RICE. The President's guidance is quite clear. We are in a technology phase that is intended to lead to a classic X-vehicle. An experimental flying machine which we are describing colloquially as a flying wind tunnel to help emphasize the magnitude and importance of the technology objectives that are associated with it.

Mr. ROHRABACHER. So you are totally committed to building this flying manned vehicle?

Secretary RICE. We are absolutely committed to the pursuit of this program. We expect it to result in a decision on the time frame we have laid out to proceed with an X-vehicle.

I want that to happen. I believe the Air Force wants that to happen.

Mr. ROHRABACHER. Excuse me, sir. Wants what to happen?

Secretary RICE. The X-vehicle that you are talking about. We all want that to happen. I do believe that the state of knowledge today does not allow us to today to commit to such a vehicle. Our expectation is that the technology program that we have laid out here now will allow us to make a prudent decision to proceed with such a vehicle on the schedule that we are now showing you.

Mr. ROHRABACHER. So you are operating under the assumption that there has not been a decision made to move forward with this vehicle?

Secretary RICE. It is quite clear in the President's guidance that the technology program is intended to lay the base for and lead to that decision, but that that is a separate decision to be made when that design issue is resolved.

Mr. ROHRABACHER. I yield to my fellow colleague.

Mr. MCCURDY. The gentleman stated in his question at least three times "manned vehicle." And in your answers, manned vehicle——

Secretary RICE. I certainly do not need to be ducking that. Our expectation is manned vehicle.

Mr. MCCURDY. Okay.

Secretary **Rice**. And we have been instructed in the Presidential guidance to consider manned and unmanned options.

Mr. **Rohrabacher**. I would like to know what you see as the mission for NASP rather than just—if we are able to develop NASP as we are trying to come to that point—what you see as a mission for the NASP.

Secretary **Rice**. Again, I would like to emphasize that the NASP is a research and technology program. We are talking about a classic X-vehicle. It will not itself have an operational mission.

On the other hand, one can visualize many areas of military operations that might well benefit from new systems developed with application of these technologies or derivations of these technologies in the future. They could be surveillance missions. Or they could be combat missions or communications missions or a wide variety of things.

But quite consciously the decision has been made at this point not to have those kind of considerations intrude into the question of the design of this X-vehicle. We all know if we let that happen, the very kinds of fears that have been expressed here this morning will surely come to pass. That a vehicle will get larger. It will get much more costly. It will have features that are simply not necessary to explore and prove out the technologies. And so a quite conscious decision has been made to set those operational mission requirements aside and to recognize that we are talking about this pre-milestone zero technology program here. It happens to have a thing that flies as part of it, but nonetheless it is still in the technology phase. It is not yet into the phase of operational systems development.

Mr. **Rohrabacher**. Okay. And you feel that the reduction that was requested, the reduction in spending or in funding that was requested by the Administration, that that stretchout—was it a 2½ year-stretchout that we are talking about? That that would simply effect the program in the terms of a 2½-year delay in coming to the end of the program, coming to fruition in the program?

Secretary **Rice**. First and foremost, I believe that that adjusted schedule reflects the reality as best we could assess it at this point about the time that was going to be required to evolve the knowledge base and do the analysis and assessments and look at the design alternatives and make a decision about a specific X-vehicle to commit to.

And so I really do not see this matter as budget-driven in the sense in which some have commented about.

Mr. **Rohrabacher**. So it does not in any way reflect a lack of commitment on your part to the goals or the Administration's part to back the goals of the program?

Secretary **Rice**. Quite the contrary. I think what we have tried to do is to lay out a program that is ambitious but one that we are confident can be sustained. And I do not believe the program that we had before would really have satisfied that mode even if it had been supported.

Mr. **Rohrabacher**. One last question then. Then we can surmise that you are totally committed to the program or we can take from your words, and that should further proposals for reducing the funding of the program emerge in the Administration in the years to come, that we will expect your opposition to those proposals?

Secretary **Rice**. I can tell you that I am personally committed to the program that we have developed here. We have our estimates laid out for the next two years beyond 1990, and it will be my personal recommendation inside the Department of Defense and the administration circle that that program continue at those funding levels.

Mr. **Rohrabacher**. Thank you very much.

Mr. **Dellums**. The gentleman yields back his time.

Mr. Secretary, Mr. Administrator, the Chair does have a number of additional questions that I would like to raise, comments that I have tried to listen very carefully to the fears that drive my colleagues to raise the kinds of questions that they have raised.

It is interesting to me that when I took the responsibility to chair the Research and Development Subcommittee, a number of distinguished persons in the scientific community and other places indicated that one of the great criticisms has been that we tend to spend too little time in research and move too quickly to development and operation, thereby not allowing us to make mistakes, to invent, to explore, to expand, which in some instances ends up doing exactly what we choose not to do. And that is to limit our technology base.

So it is interesting that my colleagues—and I just want to make that comment because I think my colleagues needs to reflect upon that.

I also will submit in writing some questions to you regarding international implications of this program. Because if my colleagues' fears are being driven by the notion that if we do not proceed expeditiously that we will lose our place as leader in this area, and not so much that other nations will not develop this technology, if the question is who gets there first, then obviously one of the questions that I would like to raise, and time does not permit at this point, but whether or not it makes sense for us and for my colleagues that there be some internationalization of this program, some aspects of the technology jointly developed in order to save money and resources because the issue is not whether the other countries get there, but how fast. Then we ought to decide whether or not it makes sense for us to move rapidly along in order to simply stay there or whether or not it makes sense to engage in some joint efforts in aspects of the technology.

But I will submit those questions to both you gentlemen in writing. And we would appreciate very much if you would respond as expeditiously as you can.

We thank you very much for your time and your patience and I hope that my colleagues feel that you have been candid in your responses to their questions. And thank you very much.

Secretary **Rice**. Thank you.

Admiral **Truly**. Thank you, Mr. Chairman.

Mr. **Dellums**. Would the Messrs. Graham, Skantz, Abell, and Gaffney come forward please.

Mr. **Walker**. Mr. Chairman, I have a unanimous consent request.

Mr. Dellums. I am sorry. The Chair would recognize the gentleman for a unanimous consent.

Mr. Walker. Sir, I ask for a unanimous consent that the documents to which I referred during my questioning of the previous two witnesses be included in the record.

Mr. Dellums. Is there an objection?

[No response.]

Mr. Dellums. The Chair hears none. Without objection, it is so ordered.

[The material referred to follows:]

Memorandum

May 5, 1989

TO: Don Rice

FROM: Jim Bonomo JLB

SUBJECT: NATIONAL AEROSPACE PLANE

COPIES TO: Bruno Augenstein, B. Bradley, G. Donohue, E. Harris,
Jim Thomson

Our project examining the National Aerospace Plane (NASP) is reaching conclusions about the prospects for that program, the X-30, and about alternative development programs. The attached writeup explains our views and suggests an alternative, one not now on the list of possible programs being considered by the National Space Council.

In particular, Bruno Augenstein and Elwyn Harris first describe the lack of a compelling mission for NASP-derived systems, and then couple that to the high technical risk and large concurrency of the existing program. This suggests an alternative, slower and smaller program that does not require a manned, single-stage-to-orbit vehicle. In contrast to existing options though, they go on to argue that the Air Force must *lead* this smaller effort, in order to force a focus on system development rather than *purely* technology development.

Since this X-30 program is of high national visibility, and consumes a large share of the Air Force 6.3a budget, we wished to share these results with you. Of course, more detail is available if you wish.

WD No. WD-4437-AF
Copy No.
Contract No. F49620-86-C-0008
Special instructions

WORKING DRAFT

DRAFT

ASSESSMENT OF NASP: FUTURE OPTIONS

Bruno Augenstein and Elwyn Harris

June 1989

WD-4437-AF

Prepared For

United States Air Force

This Working Draft is intended to transmit preliminary results of RAND research. It is unreviewed and unedited. Views or conclusions expressed herein are tentative and do not necessarily represent the policies or opinions of the sponsor. Do not quote or cite this Working Draft.

THE RAND
CORPORATION

PREFACE

This Working Draft consists of an outline presenting an alternative structure for the National Aerospace Plane (NASP) program. This examination of an alternative structure was initiated in response to the recent re-examination of the NASP program within the Department of Defense.

The work draws on the results of a continuing project, The National Aerospace Plane (NASP): Development Issues for the Follow-on Systems, RPN 4523, which was preformed within the Technology Applications Program of Project AIR FORCE.

This work may be of interest to those structuring the NASP program.

DRAFT

ASSESSMENT OF NASP-FUTURE OPTIONS

DRAFT

I. Background and Summary

We are winding up a PAF study (RCN 4523) on NASP this year. From this study we are tending to certain observations which bear on recent DoD decisions on NASP, and on the NASP deliberations which the Space Council and Congress are initiating.

Briefly, we believe that of the array of NASP program options which will likely be presented to the Council (ranging from full restoration of the NASP X-30 program, to effectively a NASA R&D program), a specific option which preserves joint DoD/NASA management of a significantly redirected and reduced annual cost program warrants close attention.

Such a program is described in the following discussion. It can actually add critical research efforts, even though the overall program pace is reduced.

II. RAND NASP Study Observations

1. Our NASP study to date suggests typical findings:

a. NASP Utility and Applications

- No compelling "golden mission" exists for NASP
- Competitors/counterparts exist for important NASP missions:
  - ALS & NASA - NASP space launch
  - ASAT plans - NASP space control
  - DARPA Pegasus - NASP quick reaction, all azimuth capability
  - NTM stable of assets - NASP surveillance capabilities
  - Others

- NASP could do many missions (but none is singularly persuasive); a very small fleet might serve NCA, SecDef in opportunistic roles
- NASP mission utility determination depends on currently unfunded subsystem work.

b. NASP Program

- ϕ Grave doubts exist that NASP could come anywhere near its stated/advertised cost, schedule, payload fees to orbit, etc.
- Schedule driven technology plan is extremely fragile, and contains unrealistic expectations.
- A very ambitious acquisition plan for coupling X-30 with operational vehicles is proposed.

c. NASP technology

- Primary NASP X-30 objective - manned single stage to orbit (MSSTO) - is exceedingly sensitive to full success in technology maturation; the hypersonic cruiser mode is more forgiving.
- Outgrowths of NASP technology drivers - high performance aeropropulsion, high temperature light structures, new design/analysis tools, integration experience with many demanding systems - will have relevance in areas such as many future military aircraft, possible commercial aircraft, industry fabrication and manufacturing advances, and general bolstering of U.S. technology base.
- The NASP program gives the U.S. opportunities to focus on many specific technologies of industrial and economic importance which might otherwise lie fallow.

2. From such findings two conclusions emerge requiring resolution:

    - On the basis of current knowledge, it is hard to defend previous DoD plans for NASP on the basis of any singular mission utility sufficiently attractive to operators.

    - But: a technology driven program could be constructed which matures many relevant technologies - albeit at a reduced pace - of intrinsic interest to the U.S., and which would also prevent "surprises" from German, French, Japanese, British and Soviet counterpart programs.

It seems to us that a Space Council/Congressional/Departmental decision on the future of NASP should accommodate these two conclusions, to best serve national interests.

In this connection, one can note that if a DoD NASP program disappeared entirely, a NASA hypersonic technology program currently exists which could continue to advance the hypersonic art (assuming NASA in turn continues its funding). The NASA program suffers from several apparent defects, however:

- It is primarily a fairly basic R&D program, the residue of earlier hypersonic vehicle work.

- It does not focus adequately on meeting major milestones and subsystem/system tests crucial for both military and commercial development decisions.

- Doubt exists in some minds that NASA management would or could step up to accomplishing such milestones and tests. Therefore the current NASP decision - devolve the residual program entirely to NASA - does not seem a preferred strategy.

III. What might a preferred NASP strategy look like? A NASP strategy worth serious consideration would be:

1. Maintain joint DoD/NASA program direction, in which, for example, NASA might monitor relevant R&D, and DoD would develop and monitor major milestone/experiment/test plans for prospective applications.

2. Redirect the current NASP program, and formulate a coherent master plan to continue fundamental NASP efforts. Such a redirection might include, for example:

   a. Reduced pace technology maturation (late 90s instead of 1994?)

   b. Initial reduced scale, unmanned flight testing; for example:

      - Module tests of aeropropulsion in Pegasus, other vehicles?

      - Component tests where possible of sensors, instruments, comm links, payload separation, controls, observables, etc. — i.e., realistic exploration of the hypersonic environment impact on operations.

      - Reevaluation of hypersonic cruiser, SSTO objectives in a phased program.

      - Compilation of data adequate to support fully a subscale or full scale manned vehicle construction and flight test series prior to commitment to such a series.

3. The content of such a redirected program would be rather different from the initial natural reactions of NASP devotees to a reduced funding level. The role of reduced scale, unmanned testing is complex to explore; the relevant arguments and responses would warrant separate treatment. The formulation of such a redirected

program into a sensibly paced, event driven, technology maturation program accomplishing critical experiments culminating in the late 1990s is a hard job warranting close attention - but the job appears doable to us.

4. Without the availability of the redirected plan, the cost estimates to attain the goals of 2. and 3. above are imprecise. However, a reasonable initial guess is that perhaps $200-300 million/year would mature the requisite technology by the late 1990s if initial emphasis includes subscale unmanned flight experiments. The numbers currently suggested - $100 M from DoD and estimated $120 M from NASA - would then coincidentally be roughly adequate if maintained annually and jointly to meet late 1990s technology maturation dates, with information then being adequate for operators' decisions on NASP continuance, and the later evolution of discrete fleet sizes.

IV. What are the potential merits of such a NASP redirection strategy?

a. Maintain vigorous technology base - research - experiment - demonstration program; the latter two aspects are needed to sustain interest.

b. Defer major funding decisions until data base is adequate.

c. Reduce the evident risks of recent/current NASP program:

- Excessive schedule driven technology risks
- Excessive USAF funding share, both absolute and as percentage of USAF RDT&E funds
- Susceptibility to political targeting of very high visibility program
- Scant/no attention to military subsystem testing

  - Excessive coupling of concurrency, short schedule, and technical risks in a single program

d. Increase the data base for follow-on and operational decisions:

  - Experiment with applications systems
  - Develop insights into utility as well as technology
  - Let missions, fleet sizes evolve, if at all, on basis of hard experiments and better defined cost data

e. Program phasing allows many decision points

f. More compatible with current budget environment

V. The suggested NASP redirection plan is premised on these understandings:

  - Prudent to maintain mainstream U.S aerospaceplane role
  - Joint DoD/NASA program management combines comparative advantages
  - A great deal learnable from subscale/unmanned tests
  - Attention to formulation of coherent flexible master test plan

All in all, the initial DRB zeroing of the NASP budget (and the proposed reinsertion of $100 M of DoD money) can be regarded as an opportunity to proceed with a more realistic NASP program which incidentally adds efforts to plumb issues of utility during an extended experiment phase.

[redacted]

[redacted]

May 17, 1989

MEMORANDUM FOR MEMBERS, NASP WORKING GROUP

FROM: MARK J. ALBRECHT

SUBJECT: WORKING GROUP MEETING

A draft of the NASP issue paper has been distributed to you under separate cover. Request each agency review that draft and provide written comments by the close of business on May 22, 1989.

The next interagency working group meeting to discuss the NASP issue will be on Tuesday, May 23,1989 from 3:30-5:00 PM in room 476 of the Old Executive Office Building. Request each agency representative be prepared at the meeting to discuss their Issue Paper comments. A briefing on foreign space plane development activities will also be presented at the meeting.

[redacted]

DRAFT
May 16, 1989

[redacted]

[redacted]

MEMORANDUM FOR MEMBERS, NASP WORKING GROUP

FROM: MARK J. ALBRECHT

SUBJECT: NASP ISSUE PAPER

PURPOSE (U): This paper outlines the National Aerospace Plane issue and analyzes policy options for consideration by the National Space Council members.

ISSUE (U): Is it in the National Interest to continue the National Aerospace Plane (NASP) program? If so, what should be the program's goals? Are flight vehicles necessary to achieve these national goals? Is schedule, or pace of activity, critical to achieve these national goals? How should the program be funded and managed?

BACKGROUND (U): As a matter of policy, the National Aero-Space Plane (NASP) has been a program of high national priority since it was announced by President Reagan in the January 1986 State of the Union address. The objectives of the program are to develop and demonstrate hypersonic and trans-atmospheric (single-stage-to-orbit) technologies which will support a variety of future national security and commercial applications. The program has also been viewed as having significant potential for furthering U.S. competitiveness and aerospace industry leadership in the twenty-first century.

(U) The NASP development program has been structured in three phases. Phase I was conducted prior to the President's announcement of the program in 1986. It included preliminary technology and applications analysis which demonstrated that an aero-space plane was feasible and useful. Phase II, is a five year technology demonstration program with the goal of proving that relevant technologies are sufficiently mature to support the development of an experimental flight vehicle (designated as the X-30). Phase II is scheduled for completion in September 1990. If the program continues into Phase III, the schedule calls for development of two flight vehicles.The first flight would occur in FY 1995 and a single-stage-to-orbit flight by the end of FY 1996.

[redacted]

[redacted]

D R A F T
May 16, 1989

(U) The NASP program has been jointly funded and managed by the DOD and NASA. The management structure includes a Joint Program Office (JPO) located at Dayton, Ohio. (The Program Director is provided by the USAF with deputies provided by NASA, the U.S. Navy and the USAF.) In addition a NASP Interagency Office has been located in the Pentagon and assigned responsibility for interaction with Congress and other elements of the Washington D.C. community. A NASP Steering Committee composed of senior DOD and NASA officials has also been formed to oversee program activities.

(U) The funding history for the program and the funding projections contained in President Reagan's FY 1990 budget are displayed below.

NASP FUNDING ($ in Millions)

	Prior	FY89	FY90	FY91	FY92	FY93-96	Total
DOD	338	231	300	390	425	1334	3018
NASA	148	89	127	119	72	213	768
TOTAL	486	320	427	509	497	1547	3786

(U) In addition to USG funding, a number of United States aerospace corporations have invested heavily in NASP technology development. It is estimated that the corporate investment to date is approximately $500 Million and that by the end of Phase II (Sept 90) it will be $750 Million.

(U) In April 1989, the Secretary of Defense, in compliance with the bipartisan budget agreement, submitted a revised DOD budget. The revised budget represents a $10.6 Billion reduction in FY 1990 from President Reagan's budget as well as commensurate reductions throughout the Five Year Defense Plan (FYDP). One component of the reduction was a decision by the Secretary of Defense to reduce the DOD share of NASP funding by $200 Million in FY 1990 and to eliminate all NASP funds after FY 1990. In addition, the Secretary of Defense proposed to transfer all management responsibilities for NASP to NASA and proposed that legislation be submitted which would allow NASA to obligate up to the $100 Million remaining in DOD NASP funds. The Acting Administrator of NASA has testified that under this scenario, the NASP program would be converted to a focused hypersonic technology program with any decisions regarding an experimental flight vehicle to be made at a later date.

DISCUSSION:

STATUS

[redacted]

[redacted]

(U) A Working Group of the National Space Council, chaired by its Executive Secretary, was convened with representation from Space Council member departments and agencies, as well as the Joint Chiefs of Staff. Terms of Reference (TOR) for the NASP study were approved and an ambitious schedule for completing the Council's review was adopted.

(U) After an initial meeting of the Working Group on May 3, 1989, participating agencies were asked to prepare inputs to aid in resolving the NASP issue. Key among the inputs were:

- An assessment by DOD and NASA as to the actions which should be taken in FY 1989 to preserve program and management options which the Council may wish to consider.

- A joint input by DOD and NASA as to technically executable NASP program options.

- A joint DOD and NASA assessment of the current status of essential NASP technologies and estimates of the technical risks and uncertainties associated with the NASP program.

- Assessments by participating agencies with regard to the importance and potential applications of the NASP program and derived technologies.

- Factual information from the DCI and the Department of Commerce regarding foreign competition in the areas of hypersonic and single stage to orbit technology development and the importance of the NASP program to continued U.S. competitiveness in the aerospace industry.

(U) DOD and NASA have assessed the current NASP program and determined that no management or funding actions are necessary in FY 1989 to preserve options for Space Council consideration.

POTENTIAL UTILITY

(U) The NASP program, if continued to completion, will produce two flight demonstration vehicles (designated as X-30 vehicles). The X-30's will be used to prove concepts and demonstrate technology. They will not have direct application for any military or civil use but will provide the technical information necessary to enable future development of a new generation of flight vehicles (NASP derived vehicles or NDV's)

(U) If the NASP is successful in demonstrating a single-stage-to-orbit capability, it will have application in virtually all aspects of government aerospace operations. Even if the program does not achieve its goal of demonstrating single-stage-to- orbit, the NASP program could well be a technology driver for

[redacted]

[redacted]

D R A F T
May 16, 1989

the twenty-first century technology base. The NASP program directs research to a technology horizon which is more advanced than any envisioned for current or planned U.S. aircraft. This long range focus is important in an age where national security and industrial competitiveness are based increasingly on high technology.

(U) Development of a National Aerospace Plane would contribute to national space policy goals by contributing to the international perception of United States leadership in the aerosp[ace field. [NASA/State: please flush out this thought]

(U) The core technologies for the NASP program have broad application throughout the industrial base as a whole. The materials technology under development in the program - - titanium aluminides, high conductivity composite, high creep strength materials and refractory composites - - will have broad application throughout industry. Indeed, Japan is already applying NASP derived materials to other industries. For example, they are using titanium aluminide turbocharger inpellors for motorcycle engines. [DOC, DOD or NASA - - are there more examples of how NASP technologies support non-NASP applications in the near term? far term?]

(U) Based on current development schedules, technical data derived from X-30 flight activities will probably not be available to support acquisition decisions (funding commitments) for civil or national security NASP derived vehicles (NDV's) before the mid to late 1990's. Thus, aero-space planes would not be available to assume operational missions until approximately the 2000-10 time frame. Projecting definitive operational requirements fifteen to twenty years in the future is not possible. However, a number of general applications have been identified for which NDV's appear to hold great promise.

(U) NASP derived vehicles (NDV's) would have application for a variety of important national security applications. NDV's could provide rapid, cost effective, flexible, and reliable access to space as well as extended hypersonic atmospheric cruise capability for a variety of candidate military missions. Military mission areas might include:

- Space Support (U): Reusable, rapid launch of payloads to low earth orbit for selected missions (e.g. satellite reconstitution, on-orbit service and maintenance of space-based systems, rescue, contingency operation, etc.) and rapid turnaround and flexible access, including an all-azimuth launch capability to achieve or modify desired orbits, are particularly attractive.

[redacted]

[redacted]

D R A F T
May 16, 1989

[redacted]

[redacted]

[redacted]

[DOC, DOT and/or NASA: Are there civil/commercial applications for NASP derived vehicles which we should state.]

TECHNOLOGICAL CONSIDERATIONS

(U) Significant technical progress has been made. Contractor X-30 conceptual designs (validated by a national technical team) easily satisfy the long range hypersonic cruise goal and meet the prime program goal, single-stage-to-orbit, with some margin. No show stoppers have been identified. The program is now in an intense period of demonstration hardware (structural components, hypersonic scramjet engines, etc.) fabrication and ground test. Program managers estimate that technical development is on schedule to support an X-30 build/fly decision in late FY 1990.

(U) There are five critical technologies central to the successful development of NASP. The status of each is outlined below:

Airbreathing propulsion (U): progress in airbreathing propulsion has resulted principally from efforts of Pratt & Whitney and Rocketdyne, coupled to extensive broad-based technology development at several government laboratories.

(U) At the beginning of the NASP Program, several ramjet development programs, most notably at NASA Langley, Johns Hopkins Applied Physics Laboratory, and Marquardt, had demonstrated subscale ramjet engine operations in shock tunnels and small wind tunnels to Mach numbers of five or six. Using this baseline, the NASP program constructed two major full-scale engine facilities capable of steady-state testing to Mach 8, modified several arc-heated propulsion experimental facilities to extend their range, and developed a number of key shock tunnel combustion rigs to simulate Mach 8-24 flow for propulsion component tests. These facilities are now operational and are currently being utilized to investigate over two dozen ramjet/scramjet engine systems and

[redacted]

subsystems developed by the expanding industrial/government NASP propulsion team.

(U) Full scale engine subsystems have been tested to Mach 7 and propulsion performance has exceeded original expectations. Computational Fluid Dynamics (CDF) analysis of mixing, combustion and engine performance is ahead of schedule and can now be used to predict experimental-sized engine performance. Thousands of data points have been obtained at velocities from M-2 to M-20. Low speed full-scale engine modules are under construction and will be tested to Mach 8.
In summary, the program now has significant experimental and analytical data which indicates the feasibility and performance of propulsion systems necessary for attainment of the NASP X-30 program goals.

Materials (U) : Materials pose the greatest technological challenge in the development of hypersonic aircraft. Early progress on the critical structural and propulsion material was insufficient and a major change in NASP materials development was necessary. To address this problem, (DOD please explain the Consortium) Since the formulation and funding of the Materials Consortium in ________, the development of high temperature, high strength materials has been significantly accelerated and is now consistent with the overall NASP schedule.

(U) Although the high temperature materials technology of the 60's and 70's was [a basis] [an encouragement] for the initiation of the NASP program, material requirements for the X-30 clearly exceeded the state-of-the-art in 1985. Early NASP materials work centered on the development of exotic alloys, metal-matrix composite and refractory composite. Although some capability was achieved with small test articles , a significantly enhanced materials program was recommended by a 1987 Defense Science Board study. Two major breakthroughs were required. First, five fundamental categories of materials needed to be characterized, developed, fabricated, scaled and manufactured in the several years remaining in the program. Secondly, the transition and utilization of this materials technology by the engine and airframe contractors had to be accelerated by a factor of two from normal practice. This was accomplished by increasing the investment in materials development approximately $100 Million/year and forming the Materials Consortium to allow collaboration and rapid application of the materials development by the system developers.

(U) Progress in Titanium Aluminides, Titanium Aluminide Composites, Coated Carbon-Carbon, and high conductivity, high temperature engine materials has been significant. Materials required for X-30 fabrication have been produced and are now being characterized and developed for subsystem fabrication.

[redacted]

Titanium aluminide structures have been built and tested to vehicle operating conditions and oxidation-resistant carbon-carbon has been produced and cycle tested to required X-30 capability. In addition, more advanced materials and components have been fabricated and tested, which provide the basis for assessing that materials development will be sufficient at the end of Phase II to allow initiation of the X-30 program.

Advanced Aerodynamics (U): Advances in aerodynamics have been rooted in an extensive amount of wind tunnel tests of inlets, nozzles, and complete aircraft models as well as major progress in the agility of computational fluid dynamics to accurately predict the very complex characteristics of hypersonic flow.

(U) In 1985, the government baseline model was the only aircraft design that had accumulated any significant design analysis. At this stage of the program, over 100 NASP configurations have been designed and over twenty-five of these configurations have received extensive wind tunnel testing. We now have the ability to develop very detailed aerodynamic configurations using 3-D Navier Stokes CFD codes which incorporate turbulence, combustion, and real gas effects within several days. While the CFD capability is the key to truly understanding the aerodynamics of the X-30, over 20,000 minutes of arc-heated, combustion-heated and shock heated wind tunnel tests have been obtained. Inlet kinetic energy efficiencies and nozzle conversion efficiencies in the 95-99% range, which is required for acceptable NASP operation, have been demonstrated. Inlet unstart and its effect on vehicle performance is now understood and acceptable. Aircraft stability and control is currently under extensive study and major advances in aerodynamic performance over the past two years have led to significant reductions in the take off gross weight TOWG of the Phase III X-30 vehicles.

(U) The ability to design vehicles with predictable engine inlet conditions while maintaining acceptable aerodynamic performance is now in hand. As configuration focusing occurs over the next year, very accurate and detailed analysis of the aerodynamic performance of the vehicle(s) will be possible using CFD. All indicators are that aerodynamic performance will exceed that necessary for acceptable X-30 vehicle capabilities.

Fuel System Performance (U): The work in NASP fuel systems has focused on (1) the feasibility of using liquid hydrogen as the baseline NASP fuel, (2) the utilization of the liquid hydrogen as structural coolant, (3) the efficient cryogenic containment of the fuel in the X-30 vehicle and (4) the potential of slush hydrogen fuel to enhance vehicle performance.

[redacted]

[redacted]

(U) The technology base of using liquid hydrogen as a space vehicle fuel was well established at the beginning of the NASP program. Its extension to aerospace vehicles has been experimentally and analytically verified and cryogenic tanks to contain the fuel in the X-30 have been constructed/tested, and characterized. Fabrication techniques are now well understood and acceptable cryogenic systems performance is virtually assured.

(U) The use of liquid hydrogen to actively cool the high temperature, high heat flux sections of the vehicle is now under careful experimental study using full scale components and realistic test conditions. Available data indicates that this approach is both feasible and enhancing to vehicle performance.

Analysis has indicated that 15-20% reductions in TOGW are possible if slush can be substituted for liquid hydrogen. In order to investigate slush feasibility, a major facility to produce, store, pump, and transfer slush has been fabricated and operated. Early results indicate that slush should behave similar to liquid hydrogen and its application to NASP vehicles should be relatively straightforward.

Advanced Avionics (U): Since Phase III of the NASP program will be limited to the development and flight testing of an experimental demonstration vehicle, avionics development has been aimed primarily at crew systems integration, aircraft and engine control technologies, and flight vehicle management systems.

(U) The requirement for aerospace plane crew, control and flight management systems can be obtained from extrapolations of Mach 3-5+ aircraft data and analysis as well as current space transportation system experience. Although early studies indicated the need for major breakthroughs in flight control and management systems, the NASP design analysis conducted during the past year has shown that a reasonable extension of current flight vehicle capability should suffice for the X-30. Development of control systems, software technology, and overall management approaches that will meet the needs of Phase III is well underway.

(U) A major activity in crew systems development has been underway since the beginning of the program. Four full-capability simulators have been developed and are in operation at this time. These simulators and their operation over the past two years have given the government and industrial teams the data needed for the X-30 crew system design.

(U) In addition to the crew station activity, several programs are underway to develop appropriate visibility approaches, display systems, high speed landing gear and tires of

[redacted]

the X-30. Logistic and supportability studies have been conducted from the onset of the program and a major subsystems consortium activity is now in place to develop instrumentation and air data systems for the Phase III program.

(U) [DOD/NASA: please provide a paragraph outlining the rationale for an experimental flight vehicle. Include some discussion of the relative merits of a hypersonic only vehicle, a single-stage-to-orbit vehicle and a technology only program that continued to rely on ground testing, CFD analysis and possibly some additional ground test facilities. (Are there distinct test facilities that would significantly enhance a "no flight vehicle" technology program?)]

MANAGEMENT CONSIDERATIONS

(U) The NASP is currently managed as a joint program with NASA and several DOD agencies involved in program management and execution. A DOD/NASA Steering Group establishes policy, guidance and broad programmatic direction and approves any changes in funding, goals and schedules. (However, this steering Group was not involved in the recent SECDEF decisions on the program to substantially eliminate DOD participation in the program and to transfer management to NASA.) The Air Force has overall program management responsibility. The jointly-manned NASP Joint Program Office at Wright-Patterson AFB, OH, executes the approved program.

(U) Government funding for the NASP program has been shared by DOD and NASA. The basis for allocation of the NASP budget between the agencies has been ______________________________
______________________________. The government management structure for NASP is [like//unlike] previous experimental aircraft (X vehicle) development programs. [DOD/NASA describe how the X-15 and other programs have been managed and the roles of NASA, DOD and industry as appropriate]

(U) Contractor investment has been an integral part of the NASP program. Major contracts are structured as fixed price contracts. Contractors knowingly bid these contracts at costs exceeding available government funds and included statements to the effect that their companies would contribute the additional funds necessary to execute the program. Thus, in addition to USG funding, industry has made a substantial financial contribution to the program. Total contractor investment to date is estimated at $500 Million with an additional $250 Million expected prior to completion of Phase II. Some of these funds have been contributed by second and third tier sub-contractors but the majority have come from the five prime contractors. Current and projected investments by the major NASP contractors are as follows:

[redacted]

[redacted]

D R A F T
May 16, 1989

	To Date	Through Phase II
General Dynamics		
McDonnell Douglas		
Rockwell		
Pratt-Whitney		
Rocketdyne		

(U) Industry involvement in the NASP program also includes participation in (several) unique consortium arrangements [DOD please provide a paragraph describing consortium arrangements]

(U) There are currently no plans to continue industry investment in the program beyond Phase II because (?)

FOREIGN POLICY AND COMPETITIVENESS CONSIDERATIONS

(U) The aerospace sector is currently one of our nations most successful in terms of international competitiveness. It generated an $18 Billion positive trade flow in 1988. Much of our competitiveness in this sector derives from technology developed cooperatively by the government and the private sector. The government contribution has come largely through the development of advanced technology military aircraft.

[redacted]

(U) The technologies under development in the NASP program are [critical] to sustaining this U.S. competitive advantage in the aerospace sector.

(U) Japan, West Germany, the United Kingdom and the Soviet Union all have aerospace plane development programs. Little is known of the Soviet Program, but they are known to have developed scale research facilities and to have an ongoing hypersonic vehicle development program which includes an aerospace plane component. The United Kingdom has stopped government funding for their program, but British Aerospace continues to support a modest research program .

[redacted]

[redacted]

D R A F T
May 16, 1989

[redacted]

[redacted]

[redacted]

[redacted]

ALTERNATIVE APPROACHES

(U) (DOD and NASA provide paragraph concerning technology development programs that may provide alternatives to NDV's for satisfying potential NDV applications (e.g. ALS, NASA hypersonic technology program, various advanced aircraft developments) How do they relate, timing complimentary aspects or whatever is appropriate).

POLICY AND IMPLEMENTATION OPTIONS (U):

[redacted]

[redacted]

D R A F T
May 16, 1989

OPTION 1 (U): Reconfirm the high national priority of the NASP program and the need for an aggressive national effort.

Implications (U): This policy statement would imply that the USG intends to pursue the NASP program toward the objectives and on the schedule recommended in President Reagan's FY 1990 budget (Single-Stage-to-orbit goal, X-30 build and flight decision in late FY 1990 first flight in 1995 and single-stage-to-orbit demonstration in 1996.)

Implementation (U):

- An FY 1990 budget adjustment would be required and funding would have to be planned in FY 1991 and beyond. $200 Million in additional funding would be needed in FY 1990 to return to President Reagan's recommended program. FY 1990 requirements could be reduced to $100 Million by slipping the program one year. The current funding profile (adjusted for inflation) would be resumed in FY 1991.

- Program management could be transferred to NASA as proposed by DOD or it could continue to be exercised through the current joint management approach. The current NASA budget does not have sufficient flexibility to accommodate an adjustment and a supplemental would be required. Further, it would be very difficult to sustain the large costs involved in FY 90 and the FY 91-96 period (in excess of $2.1 Billion) within the NASA budget. For these reason's, and because the present management systemhas been effective, current DOD/NASA management arrangements should be retained.

PRO'S (U)

- Consistent with previous policy of support for NASP last expressed by President Bush in his first address to the joint Session of Congress in March 1989.

- Consistent with technology driven program.

- Supports continued U.S. competitiveness in critical aerospace industry

-Provides basis for decisions on NDV's at the earliest possible time to support important future civil and national security applications (e.g. low cost, reliable access to space etc.)

-Signals continued support to industry. Provides high likelihood of continued industry investment which will reduce the total cost of the program.

CON'S (U)

[redacted]

[redacted]

- Requires substantial change in FY 1990 budget. Difficult priority trade-offs to identify offsets for unfunded NASP requirements. There are also significant unfunded cost and priority implications throughout the FYDP.

- Requires a Presidential decision to override the SECDEF on an issue of budget priority within the DOD.

OPTION 2 (U): Determine that the NASP program is primarily of Departmental (rather than national) Interest and should be pursued at a scope and a pace consistent with Departmental priorities.

Implications (U): This policy statement would imply that decisions on NASP are properly made through the budget process. It would signal that NASP should compete with other priority programs of DOD and NASA and that the Administration has no substantially greater interest in NASP than it does in other departmental programs (e.g. F-15's, NASA science missions, submarines etc.) which are funded and executed by NASA or DOD. Based on current budget submissions and statements to congress, selection of this option would probably result in a restructured NASP program focused only on hypersonic technology and with no near term plans for a demonstration vehicle, either for hypersonic flight or for single-stage-to-orbit. It would also transfer management responsibility to NASA.

Implementation (U): This policy option is consistent with current budget planning. The only actions necessary are those associated with executing the FY 1990 budget.

PRO'S (U)

- Consistent with the Administration's current budget request to the Congress

-Probably would provide a basic technology program focused on hypersonic flight within the atmosphere

- NASP applications can be considered within the context of their mission context and compared with other technical approaches for satisfying national security and civil needs

- Consistent with normal planning, programming and budgeting process

CON'S (U)

- Delays indefinitely many of the potential applications of NASP and NDV's.

[redacted]

[redacted]

-Negative impact on the future competitiveness of the U.S. aerospace industry

- Industry would probably cease investing in NASP and NASP related technologies raising the long term cost to the government of eventually developing a trans-atmospheric capability.

OPTION 3 (U): Identify NASP as a program of broad national interest which should be pursued at a measured pace based on technology and cost.

Implications (U): The NASP program would be continued but restructured to reduce cost [eventually we will need to quantify this cost reduction] and/or technical risk. This policy would probably involve continuing the Current NASP program through Phase II (possibly at a somewhat slower pace in FY 1990/91), developing cost and schedule criteria which could be used to support a phase III decision and restructuring implementation of Phase III. A variety of alternatives exist for restructuring Phase III consistent with this policy objective.

Implementation (U):

Alternative A: Restructure Phase III of the NASP program to demonstrate hypersonic flight. Defer single-stage-to-orbit capability until after hypersonic flight has been demonstrated.

PRO'S (U)

- Reduced technical risk

- Provides technical basis to support many important civil and national security applications such as [DOD/NASA/DOC provide examples].

- Supports continued U.S. competitiveness in the aerospace industry

-Allows the U.S. to make long term NASP decisions based on solid technical and programmatic data

CON'S (U):

- May not be sufficient government investment or sufficiently aggressive technology development effort to sustain industry interest and financial investment.

- Approach would require development of two different experimental vehicles to achieve all the objectives of the NASP program (i.e. single-stage-to-orbit).

- Probably more costly program in the long term.

[redacted]4

- Many of the potential space applications of NDV's would be deferred for ____(5?)__________ years.

Alternative B: Restructure Phase III of the NASP program as a cooperative government/industry partnership, possibly modeled on the materials consortium approach but in which industry participated in defining program objectives and in funding the program. [DOD/NASA: we need input from industry to determine if such an alternative makes any sense] [OMB, thoughts on how such an arrangement might work and inducements USG might offer to help encourage such an arrangement?]

PRO'S (U):

- Consistent with USG policy to foster and encourage commercial space.

- Consistent with government/industry partnership concept for strengthening U.S. competitiveness. [OMB/DOC true?]

- Potential for retaining industry investment through Phase III with commensurate reductions in government expenditures.

CON'S (U)

- Reduced government control of program objectives, technical specifications etc.

- Legal and contractual issues that need to be understood [DOC/DOD/NASA please research feasibility and technical issues]

Alternative C: Restructure Phase III to support a cooperative international program, possibly with West Germany, the United Kingdom, ESA and/or Japan.

PRO'S (U)

- Potential for reduced program cost, however scope and/or pace of the program may be different from that desired by U.S.

- Potential advantages for U.S. foreign policy [Department of State, please provide input.]

- Potential to provide access to state of the art technology being developed by Japan, West Germany etc.

- Allows U.S. Industry to keep pace with Western competitors

CON'S (U)

[redacted]

DRAFT
May 16, 1989

- Technology transfer concerns [DOD, State please amplify]

- Allows foreign competitors to catch up with the U.S. aerospace industry, an industry which currently provides an $18 Billion positive trade flow.

- Scope, pace and objectives of the program would be subject to negotiation with international partners

- International partners might seek to limit or preclude DOD participation in the management of the NASP program.

[redacted]

Summary of Japan

Technical Work... high quality, wide scope

Facilities... small, adequate for research,
not for development

Design effort... starting, immature

Program status... consensus building

Collaboration... domestic and foreign, demonstrated

Space Infrastructure... planned, space plane included

Japan will probably collaborate on a space plane

French are actively engaged in discussions

Foreign Space Plane Views

1. All major countries have a goal for independent launch capability (Japan's additional goal is a space plane construction infrastucture)
2. All recognize that space planes are the ultimate transportation system
3. All recognize that space plane technology will impact commercial economic competiion
4. All have space plane related efforts
5. Most are positioning themselves for international collaboration (particularly Japan)
6. Most have small budget committments for space planes (except Germany)
7. Few have all the necessary facilities (except Soviets)

Mr. **Dellums**. The Chair would like to welcome before the Joint Hearing this afternoon Dr. William Graham, Senior Vice President, JAYCOR; General Laurence Skantz, U.S. Air Force (Retired); Mr. Bruce Abell, Hudson Institute, Herman Kahn Center; and Mr. Frank J. Gaffney, Jr., Director, Center for Strategic Policy.

The Chair would like to welcome all four of you distinguished gentlemen before the Joint Hearing this afternoon, and without objection, the full text of your prepared and printed remarks will appear at the appropriate point in the record.

And the Chair would recognize Mr. Graham to begin the testimony.

Mr. **Graham**. I will submit my statement for the record and just make a few brief remarks, if I might.

Mr. **Dellums**. Please proceed, sir.

STATEMENT OF WILLIAM R. GRAHAM, SENIOR VICE-PRESIDENT, JAYCOR

Mr. **Graham**. Having worked as the President's Science Adviser to try to regain U.S. leadership in advanced technology areas where we have in fact lost ground and sometimes lost that leadership; areas such as semi-conductors where Mr. Valentine and Mr. Ritter have played such a significant role in bringing us back, superconductivity, machine tools, and so on, it is a great pleasure to address an area today where the United States is the unchallenged world leader in aeronautics civilian, military and space applications.

The National Aero-Space Plane Program certainly continues the U.S. position in that area. And, in fact, the Aero-Space Plane Program today is driving most of our total national effort in computational fluid dynamics, both vehicle and propulsion design, high-temperature long-lifetime materials, advanced fabrication and assembly processes, liquid hydrogen fuel systems, adaptive controls, and efficient integration of vehicles over a wide range of performance. I think most important is the management of technologies having high technical risk associated with them.

This country gives up enormous advantages that arise out of its research laboratories by not putting sufficient attention to the management of the risk of incorporating those technologies in eventual commercial and national securities applications. I believe the Aero-Space Plane Program is at the lead of that risk management. It is taken extremely seriously in the program and done in an exceptionally innovative and professional manner. Many of our other industry and government programs need to derive further benefit from that work.

Equally significant, the program brings together our total national capability—something we are going to have to do if we are going to maintain our competitiveness with other countries that have mastered this skill. It brings together the Defense Department, the Air Force and DARPA, NASA headquarters and three major aeronautical centers of NASA, and five of our best industrial aerospace companies supported by a very broad range of subcontractors in the industry.

To attain the full value from this investment, we need to structure more activities along the lines not only of the present competitive program, but I believe in a way that is reflected in a cooperative nature of the materials consortium that was formed by these five strong competitors with government participation. The fact that they are able to compete in the aero-space plane design while these same industrial contractors are cooperating very closely in materials work for the Aero-Space Plane Program is reminiscent of a capability that I have long admired in Japanese and other foreign industries, and something we need to pursue more widely. This program is certainly a leader in that process.

Finally, the Aero-Space Plane Program is at the end you mentioned a few minutes ago, Mr. Chairman, the narrow end of the funding wedge that goes into the advanced technologies of the 21st century. We have enormous leverage now on our aeronautical capabilities in the 21st Century at what will prove to be an extremely modest cost now compared to the investments that we will make in the future.

The fact that U.S. industry is matching government funding with its own private commercial dollars shows our industries' willingness to invest not just in the next week but in the next century, over a decade from now—a willingness to take a long-range industrial approach that all too few industries are in fact willing to take today. That willingness is a sign of their strong leadership, commitment, and their understanding of the importance of this program to themselves and to the country.

There is nothing easy about the aero-space plane. But it should be and is a technology-driven program. We have made more progress in the last 3 years in hypersonic aerodynamics and propulsion than we have made in the past 30 years.

This progress was made under the severe budget constraints that the previous administration as well as this one had to operate. It was the belief of the past administration that the Aero-Space Plane Program, as outlined by President Reagan, was a minimum level of support necessary to engender the efficient participation of industry to accomplish the technological progress that we need. That technological progress is still being made, in fact, at a rate that is higher than we would have anticipated. And I believe those assumptions are still valid today.

In summary, I would say that the Aero-Space Plane Program has generated not only the support of the services, the Defense Department and NASA, but also of our industry and certainly very strong interest in many foreign countries as well. And I believe that the program warrants the strongest possible support from your committee.

Thank you.

[The prepared statement of Mr. Graham follows:]

William R. Graham

Statement to the Subcommittee on
Transportation, Aviation and Material

and

Subcommittee on Research and Development

"The National Aero-Space Plane"

August 2, 1989

The National Aero-Space Plane is a forward-looking Presidential initiative to advance our aerospace technologies and retain U.S. leadership in the 21st century. President Reagan announced it in his State of the Union address on February 4, 1986, and both he and President Bush have reaffirmed their support for the program on several occasions. Bob Williams, Bob Cooper, Larry Skantze, Ray Colladay, Pete Aldridge, and Jay Keyworth, also played important leadership roles in the development of the NASP program. Another key group was the Defense Science Board Task Force on the NASP, under the leadership of Joe Shea. The Task Force spent a great deal of time evaluating the NASP program. Their work has certainly raised a few eyebrows, and they gave the program a good wire brushing. The useful suggestions they generated are being implemented in the program and their evaluation was very constructive.

That does not mean the National Aero-Space Plane program isn't without risk today. On the technical basis, it shouldn't be without risk. If we were pursuing a no-risk program we should go back and change the terms and conditions, because the program was designed to accelerate our technology, not just use existing capabilities. To developing a machine capable of using airbreathing propulsion to reach nearly orbital velocities requires very special materials and very special engine technologies that were thought nearly impossible just a short time ago. We have asked the aerospace industry to move from evolutionary improvements to revolutionary steps, and I am pleased to report that they are making impressive progress.

Approximately 85 years has elapsed since the first flight, and 40 years since we reached Mach 1. We now have airplanes regularly in operation at Mach 2 and even Mach 3. And we are pressing the bounds of technology to go even further to develop a single-stage-to-orbit Mach 20 plus vehicle in the next few years. A great challenge, but I believe it can and will be done. It's a matter of time and resources, both financial resources and human resources, to make it happen.

The diversity of applications of NASP technology can only be guessed at today, but they certainly include increasing our access to space and travel anywhere on Earth in just a few hours. We will be able to pursue a new approach to a space transportation system to go to, for example, satellites, instruments, man-tended commercial platforms, or the Space Station. It could be an integral part of the President's major space initiative for returning to the moon and then moving outward into the solar system.

In some cases, the contractors in the program are spending several of their own dollars for every dollar they are getting from the government. Contractors have matched total government funding to date on this program and have planned to spend more than $600 million dollars of their own discretionary funds before 1990. The program strongly supports Deputy Secretary of Defense Atwood's call for strengthening the U.S. advanced technology base. Those in the government and in industry are working together closely to assure that this program pays off in U.S. aerospace capability and leadership.

One recommendation of the Defense Science Board was to increase the pace of materials research for the program. Because of this recommendation, industry and the Joint Program Office created what I think is the most exciting and forward-looking part of the program--the NASP Materials Consortium.

This materials consortium is a lesson to be remembered and repeated often in the future. The United States aerospace industry is today in a leadership position, and if we work together, as our foreign competitors are learning to do so well, we can retain and strengthen our position.

The five contractors--the three airframers, General Dynamics, McDonnell Douglas, and Rockwell, and the two engine contractors, Pratt and Whitney and Rocketdyne--have certainly combined their talents to work and solve the materials problem. You can imagine how this would have been viewed a few years ago, when these strong competitors suddenly united, setting aside their fierce competition, to work on these materials problems that had previously seemed nearly impossible.

I would like to see the NASP Materials Consortium form the basis for a broader NASP consortium, one that would address other tough problems that we must deal with in the R&D area and more generally serve as a model for future joint aerospace ventures. When all of the contractors, subcontractors, universities, laboratories, and government facilities are put together, the NASP consortium represents a large share of our aerospace industry--an industry whose achievements are growing every day.

There is no question that there is a lot of pressure on technology in the Defense budget today. But it is important to remember that we maintain our advantage over our adversaries not by competing with them tank for tank and man for man, but by drawing on our advanced technology to give us leverage over them. The NASP is a prime example of a brilliant technology concept that offers the opportunity to focus our research investment and to aim at major advances in capability. With strong and consistent administration, congressional, industrial, and public support, the National Aero-Space Plane program will continue to build the technological and industrial foundation of U.S. aeronautical and space leadership in the 21st century.

Mr. **Dellums**. I thank the gentleman.

General Skantz.

STATEMENT OF GENERAL LAURENCE SKANTZ, U.S. AIR FORCE (RET.)

General **Skantz**. Mr. Chairman, I am pleased and honored by your invitation to present my views before this committee on the National Aero-Space Plane.

I have submitted a brief statement for the record but I would like to read it with your indulgence.

From my perspective, in the broadest sense, this Nation's venture into the exploration and the assimilation of space is both consistent and inconsistent. It is consistent in that by his very nature man will inexorably continue to push the frontiers of space. Yet it also is inconsistent in that an enduring space policy has always been elusive.

We as a nation have waxed through varying periods of enthusiasm, reluctance and indifference with respect to space activities. We struggled through the early satellite dates, reluctantly started the Mercury program, gloried in the years of dramatic manned Apollo launches, and then watched the sad destruction of Sky Lab, then tried to initiate the shuttle program on a shoestring budget.

It is truly a difficult and challenging process to a nation and government that engage in white hot debates over annual budget allocations to find the time to pause and apply vision to where the United States ought to apply its resources and establish goals that will put this nation in the forefront of man's future in space.

I believe very strongly that the National Aero-Space Plane is the right goal and the right program at the right time to do just that. It is not a new idea. In the early 1960s the Air Force created an Aero-Space Plane Program. It was a dramatic concept of a large air vehicle that would take off and land horizontally and, using the Earth's atmosphere as a fuel supply, fly from Earth into orbital space and return. The potential of achieving a tenfold increase in the payload fraction was exciting. But it required exotic technology that was not there in the early sixties. The program died quietly and quickly and appropriately but the concept survived.

In 1980 we revisited the concept within the Air Force but with more pragmatism. Before initiating any activity we asked ourselves the following questions.

Given that we could develop an aero-space plane, what missions would it perform? Were the missions unique? Were they useful? Were they cost effective? What were the key technical challenges and could they be met? If so, what were the specific technology programs that needed to be pursued? If properly laid out, could they lead to the necessary performance thresholds?

From this series of questions and subsequent answers emerged the Transatmospheric Vehicle Concept Studies or (TAV) which led to studies to develop the required technical road map and establish the soundness and engineering feasibility of the goals. Interest continued to grow and from Air Force Project Forecast II which I initiated in the summer of 1985, it was not surprising that one of the findings to guide the Air Force to the year 2000 was that the technologies needed for an aero-space plane were feasible and the road map was clear.

In early 1986 I also became familiar with the Defense Advance Research Project Agency's Copper Canyon Project which was exploring the basic feasibility of multi-mode engine concepts for hypersonic propulsion, with direct application to an aero-space plane.

It was clear to me that indeed we were ready to create a focused technology exploration program leading to an experimental vehicle. Realizing both the breadth of interest and the enduring fiscal commitment required, I decided we needed to create a national program which would pull together all the vast technical talents from the Air Force, Navy, DARPA and NASA.

I proposed to then Air Force Secretary Aldridge that I would establish an integrated program office the Air Force's Aeronautical Systems Division reporting directing to me and that it would be called the National Aero-Space Plane Program. Secretary Aldridge was instrumental in getting approval of then Secretary of Defense Weinberger and President Reagan.

The program was laid out. Agency agreements were negotiated and we built up the integrated office that exists today with a smooth functioning team of DARPA, Air Force, Navy and NASA participants. Subsequently, all of the DOD funding was consolidated in one Air Force line supplemented with an equivalent NASA line.

From the outset, the hard thrust of the program was to vigorously attack the technological challenges in the aero-space plane vehicle structure, materials, and cooling concepts as well as propulsion. Technical risk reduction and demonstration were clearly the near-term goals but crucial to the NASP Program was the need to have a research vehicle, a concept to provide a focus to the technical thrust particularly in the area of vehicle propulsion integration. Vast Computational challenges had to be overcome to provide insight to the hypersonic flight environment.

Because of the nature of the risk reduction, the date for a decision to initiate an X-vehicle was identified in 1991 but with considerable uncertainty. Because of that, I always referred to it as a "Moveable Feast." Clearly, that decision would be paced by technology maturation.

The X-vehicle concept is and must be kept austere. Its purpose is to explore the flight regime and gradually demonstrate the achievable performance. It does not need a payload nor does it need any go around capability. It ought to be the true successor to the X-15. I believe that the NASP Program has made great progress and that the promise of a true operational capability in the future is real.

To the Air Force, that will mean the ability to operate either hypersonic vehicles in the upper reaches of the atmosphere or inject payloads into space from a wide choice of conventional runways. The vulnerabilities of two fixed-launch centers at Kennedy and Vandenberg has always given the Air Force and DOD great concern. The hypersonic vehicle concept also offers a quick rapid manned capability to any point on the globe.

Finally, the deterrent capability inherent in the manned vehicle which has the speed of an ICBM but can bring man judgment to the end game provides enormous flexibility. More enduring, however, is the promise of reducing the cost of payloads to orbit by as much as a factor of 10. That has a broader implication for man's continued journey into space for generations to come.

I believe, Mr. Chairman, that the NASP is the great undertaking for this country in this next decade. It does take a sense of vision and commitment that are uncommon in our intense annual budgeting process. Without that visionary leadership from the President and Congress, NASP is a very fragile program, subject to the vagaries of annual expediency.

I hope it will survive and with sufficient funding and backing to sustain it over the next decade. I hope the NASP management team will be kept together to lead the program. Shifting it to another agency will turn back the clock and dismember a coalition that was carefully and painstakingly put together. The goal is there. The focus on an austere X-vehicle is there. There is no other singular program that offers the impetus to this nation and mankind to make space operations a routine affordable reality in the next century. It will dramatically put the United States permanently in the forefront of space. That will be a legacy worth achieving and worth leaving. It needs but a handful of committed visionaries to make it happen. And that achievement is clearly within our grasp.

Thank you, Mr. Chairman, for the opportunity.

[The prepared statement of General Skantz follows:]

THE NATIONAL AEROSPACE PLANE

Mr. Chairman, I am pleased and honored by your invitation to present my views before this Committee on the National Aerospace Plane program. I have a brief statement that I would like to read.

In the broadest sense man, and this nation's venture into the exploration and assimilation of Space is both consistent and inconsistent. It is consistent in that, by his very nature, man will inexorably continue to push the frontiers of space. Yet it also is inconsistent in that an enduring Space policy has always been elusive. We, as a nation have, waxed through varying periods of enthusiasm, reluctance, and indifference with respect to space activities. We struggled through the early satellite days, reluctantly started the Mercury program, gloried in the years of the dramatic manned Apollo program, watched the sad destruction of Sky Lab, then tried to initiate the Shuttle program on a shoe string budget. It is truly difficult and challenging to a Nation and Government, that engage in white hot debates over annual budget allocations, to find the time to pause and apply vision to where the United States ought to apply its resources and establish goals that will put this nation in the forefront of man's future in space. I believe very strongly that the National Aerospace Plane is the right goal and the right program, at the right time, to do just that.

The aerospace plane is not a new idea. In the early 1960's the Air Force created an aerospace plane program. It was a dramatic concept of a large air vehicle that would take off and land horizontally, and using the earth's atmosphere as a fuel supply, fly from earth into orbital space and return. The potential of achieving a ten fold increase in payload fraction was exciting but it required exotic technology which wasn't there in the early sixties. The program died quickly and quietly, but the concept survived.

In 1980 we revisited the concept within the Air Force, but with more pragmatism. Before initiating any activity we asked ourselves the following questions:

1. Given that we could develop an aerospace plane what missions would it perform?
2. Were the missions unique, useful and cost effective?
3. What were the key technical challenges and could they be met?
4. If so what were the specific technology programs that needed to be pursued and, if properly laid out, could they lead to the necessary performance thresholds?

From this series of questions and subsequent answers emerged the Transatmospheric Vehicle (TAV) concept which led to studies to develop the required technical roadmap and establish the soundness and engineering feasibility of the goals. Interest continued to grow and from Air Force PROJECT FORECAST II, which I initiated in the summer of 1985, it was not surprising that one of the findings to guide the Air Force toward the year 2000 was that the technologies needed for an aerospace plane were feasible and the roadmap was clear. In early 1986 I also became familiar with the Defense Advanced Research Project Agency's COPPER CANYON Project which was exploring the basic feasibility of multi mode engine concepts for hypersonic propulsion, with direct application to an aerospace plane. It was clear to me that indeed we were ready to create a focused technology exploration program leading to an experimental vehicle. Realizing both the breadth of the interest and the enduring fiscal commitment required, I decided we needed to create a national program that would pull together all the vast technical talents from the Air Force, Navy, DARPA, and NASA. I proposed to then Air Force Secretary Aldridge that I would establish an integrated program office at the Air Force's Aeronautical System's Division, reporting directly to me and that it be called the National Aerospace Plane program. Secretary Aldridge was instrumental in getting approval of then Secretary of Defense Weinberger and President Reagan.

The program was laid out, agency agreements were negotiated, and we built up the integrated office that exists today with a smooth functioning team of DARPA, Air Force, Navy and NASA participants. Subsequently all of the DOD funding was consolidated in one Air Force line, supplemented with an equivalent NASA line.

From the outset the hard thrust of the program was to vigorously attack the technological challenges in aerospace vehicle structure, materials, and cooling concepts, as well as propulsion. Technical risk reduction and demonstration were clearly the near term goals, but crucial to the NASP program was the need to have a research vehicle concept to provide focus to the technical thrusts, particularly in the area of vehicle/propulsion integration. Vast computational challenges had to be overcome to provide insight to the hypersonic flight environment. Because of the nature of risk reduction, the date for a decision to initiate an X-vehicle was identified in 1991 but with considerable uncertainty. Because of that I have always referred to it as a "Moveable Feast." Clearly that decision would be paced by technology maturation. The X-vehicle concept is and must be kept austere. Its purpose is to explore the flight regime and gradually demonstrate the achievable performance. It does not need a payload, nor does it need any go around capability. It ought to be the true successor to the X-15. I believe that the NASP program has made great progress and that the promise of a true operational capability in the future is real.

To the Air Force that will mean the ability to operate either hypersonic vehicles in the upper reaches of the atmosphere or inject payloads into space from a wide choice of conventional runways. The vulnerability of two fixed launch centers at Kennedy and Vandenberg has always given the Air Force and DOD great concern. The hypersonic vehicle concept also offers a quick rapid manned reconnaissance capability to any point on the globe, much more quickly than reprogramming a satellite which may take several orbits to get into position. Finally the deterrent capability inherent in a manned vehicle which has the speed of an ICBM, but can bring manned judgement to the end game, provides enormous flexibility. More enduring, however, is the promise of reducing the cost of payloads to orbit by as much as a factor of ten. That has a much broader implication for man's continued journey into space for generations to come.

I believe, Mr. Chairman, that NASP is the great undertaking for this country in this next decade. It does take a sense of vision and commitment that are uncommon in our intense annual budgeting process. Without that visionary leadership from the President and Congress NASP is a very fragile program, subject to the vagaries of annual expediency.

I hope it will survive, and with sufficient funding and backing to sustain it over the next decade. I hope the NASP management team will be kept together to lead the program. Shifting it to another agency will turn back the clock and dismember a coalition that was carefully and painstakingly put together. The goal is there, the focus on an austere X-vehicle is there. There is no other singular program that offers the impetus to this nation and mankind to make space operations a routine affordable reality in the next century. It will dramatically put the United States permanently in the forefront of Space. That will be a legacy worth achieving and worth leaving. It needs but a handful of committed visionaries to make it happen, and that achievement is clearly within our grasp.

Thank you Mr. Chairman for the opportunity to address this Committee.

Mr. **Dellums**. Thank you very much, General, for your opening remarks.

And Mr. Abell, before we proceed to you, the Chair would like to indicate to my distinguished colleagues of both panels that unfortunately the Chair has a meeting with the Speaker, the chairman's meeting at 12:30 and the Chair would like to first ask Mr. McCurdy if he would assume the responsibility of the Chair until as such time as Mr. Valentine returns and it would be the hope that you would yield to him to proceed.

But before the Chair leaves, I would just like to ask Mr. Graham one question.

You began your testimony speaking to the question of risk, and I would like to ask you a question regarding risk.

Are there any risks from your perspective associated with moving rapidly toward the operational phase. For example, if there is tremendous pressure to move a research program to the operational phase, does that mean that the bureaucratic pressure becomes so great that you develop an experimental effort that may not necessarily be the best technology but the available technology at that point? And are there risks associated with moving too rapidly from the research phase to the operational phase which tends to be the order of the day, at least in terms of how we operate with respect to the Pentagon because when you look at our budget, a small amount of money in research, much larger amounts of money in development and operational phase, because it is get that vehicle, get that weapon, get that missile. And so it does not provide us with the opportunity. And there are a lot more dollars when you get out to the operational phase than there are when you are spending money making mistakes and inventing and what have you.

Mr. **Graham**. Mr. Chairman, by "operational phase," do you mean the phase where we would finally go beyond the aero-space plane into operational civil and military hypersonic flight? Or do you mean going from the research and conceptual design phase we are in now to the development and operation of a purely research vehicle which is the X-30?

Mr. **Dellums**. Well, probably the latter. For the purposes of this discussion because that is where these questions have been clearly going.

Mr. **Graham**. In fact, one of the challenges of the risk management in this program is knowing when to move to the full-scale design of the research vehicle. I have talked to the program management and the contractors about this, and they all have a clear understanding that this is a technology-driven program. We are driving the technology toward flight capability. A manned-research aircraft capability. And periodically we converge the design, see where it is, see where it needs to be improved, and do another iteration. That process will continue.

I believe we are making very rapid progress there but I also believe that we will not finally freeze that design until the program management and the consortium of Government sponsors is satisfied that we have a viable vehicle.

So I think we have the management tools in place and the realization of the risk in place to balance the need to get this experimental flying wind tunnel operating, and the need to bring along the technology, to mature the technology we need to make a really revolutionary aircraft.

Mr. **Dellums**. Thank you very much.

Mr. Valentine, I would appreciate it if you would chair the rest of these proceedings. I have to go to a chairman's meeting with the Speaker.

Mr. **Valentine**. Mr. Abell, if you would proceed with your statement.

STATEMENT OF BRUCE R. ABELL, SENIOR RESEARCH FELLOW, HUDSON INSTITUTE

Mr. **Abell**. Thank you.

Mr. Chairman, my involvement with the National Aero-Space Plane dates back to work in the White House Office of Science and Technology Policy with Dr. George Keyworth, President Reagan's Science Adviser from 1981 until the end of 1985.

I know that the committee had hoped that Dr. Keyworth could testify today. Unfortunately he is out of the country and he regrets very much that he could not be here in person. However, he and I prepared this testimony jointly and it reflects his perceptions and views of NASP as well as my own.

The overriding importance of NASP is that it is a key to solving two critical problems that challenge America's future. One is the simple fact that the glory of our space program is fading and we are not likely to re-earn that glory through rhetoric or by clutching on to the technology of the past. Our current program offers big promises but little inspiration.

Where Apollo challenged our American ingenuity, today's program mingles old technology with deja vu. But even though modest efforts are based on unrealistic and in fact disproven assumptions about our ability to provide access to space. Current space-lift capabilities and technology cannot handle even today's demand, never mind those that would be imposed by a space station, new manned exploration, or defense needs. The NASP is the missing ingredient—the kind of technical challenge that drives innovation and the new technology that can make access to space truly routine. And by truly routine, we mean at far lower cost and with much higher reliability than ever be achieved with rockets.

In addition, NASP is the pathway to the next generation of aircraft, an area of technology and industry that America still dominates but where current technology will, like the vacuum tube, become obsolete.

The second problem that NASP addresses is no less important, advanced manufacturing. The NASP, initially under DARPA's visionary direction, and now as an excellent Air Force and NASA program, has become in both industry and academia a highly focused highly urgent challenge that has driven a remarkable degree of technological team work and technological progress.

A national commitment to the NASP, of the kind that we had until this recent slowdown, can drive the emergence of real advantage for Americans. It will help our industries, first aerospace and defense, and then commercial, master the technology of manufacturing advanced materials and become more competitive in world markets. But without such a commitment now, in future years we can expect to be hearing the same debate we hear today about automobiles and silicon over how the United States can compete with the advanced-manufacturing practices of other nations.

These to us are the real issues behind the debate over the NASP. We believe the most important thing we can do with these hearings today is to call attention to that space role for the NASP as an urgent argument for restoring full funding and unquestioned commitment for the program and get it back on a fast track.

Five years ago we were convinced that the prospects of a successful NASP were good and that it would be so far-reaching that this little known effort should become a high priority national effort. In a relatively short time, the NASP achieved that priority and became a major new technology development program.

Moreover, the excellence that DARPA built into its early program has been carried forward into this new program. It has attracted some of America's best aeronautics and aerospace talents. It has stimulated substantial new industrial investment in advanced materials and hypersonic aeronautics and produced remarkable results. It has developed innovative means of speeding research and share in results among participants and it has maintained an even extended the program's initial excitement as we get closer to what had been the 1990 goal of selecting the most promising approaches for actual development.

So it is ironic that at a time when we are searching for a means to revitalize our troubled space program, we are on the verge of crippling this unique American tool for leadership.

Finally, let us reemphasize the implications for national competitiveness because we believe there are of no less importance. The United States has a very difficult time in mounting large-scale long-term technology development programs, especially those programs in government and commercial interests overlap, and especially those programs that require cooperation from organizations that are instinctively competitive. When we observe the speed and efficiency with which our major technology competitor, the Japanese, have organized broad long-term R&D efforts in areas like superconductivity or high definition television, we are driven to anguished national self-examination about why we cannot do that. Those and other recent examples have fed a growing worry about American technology policy.

The Congress has devoted immense effort over the past two years to searching for effective and appropriate models for American technology development. We are looking and experimenting with dozens of possible approaches to stretch our investment horizons and pool scarce science and technology resources.

Yet here we are about to deemphasize the NASP Program, one of the best of the few truly successful government-industry technology development partnerships, in an area where the United States probably has its best opportunity to emerge as the international leader, where its success will undergird our most successful technology export, aerospace.

Certainly if we are looking for an example of an effective kind of U.S. technology policy, the NASP seems made to order. There is no question about its legitimacy as a government program. The government is the initial customer for the products. And at the same time, the solution of the technical challenges, especially in advanced materials, will prove highly beneficial to U.S. industry in broad areas of application.

The unique importance of the NASP Program is that it gives engineers an application-driven test bed to develop that next generation of materials. But to capture that benefit, we must have as an uninterrupted program goal, the building of an aircraft. Without that focus, without that demand that systems perform under operational conditions, we are unlikely to reap the large benefits we have been expecting.

No one can come before the Congress and lay out a neat version of U.S. technology policy or industrial policy. More likely, it will evolve in stages as we sort out the successful and unsuccessful attempts to form productive partnerships. NASP is one of the productive ones. And to let it be gutted now would be a disheartening message for America.

Mr. Chairman, that concludes Dr. Keyworth's and my testimony. Thank you.

[The prepared statement of Mr. Abell follows:]

Testimony of

Bruce R. Abell
Senior Research Fellow
Hudson Institute
Washington, D.C.

Dr. G. A. Keyworth, II
Director of Research
Hudson Institute
Indianapolis, Indiana

To the Committee on Science, Space, and Technology
Committee on Armed Services
United States House of Representatives

Joint Hearing on the National Aerospace Plane
August 2, 1989

Mr. Chairman and Members of the Committee:

My name is Bruce Abell. I am a Senior Research Fellow at Hudson Institute, a public policy research organization. My involvement with the National Aerospace Plane dates back to work in the White House Office of Science and Technology Policy with Dr. George Keyworth, President Reagan's Science Advisor from 1981 until the end of 1985. I know that the Committee had hoped that Dr. Keyworth could testify today. Unfortunately he is out of the country, and he regrets very much that he could not be present in person. However, he and I have prepared this testimony jointly, and it reflects his perceptions and views of NASP as well as my own.

We should offer just a little history to start with. Almost five years ago, when DARPA first made a presentation to the Science Advisor and his staff about the NASP, the effects on us were electrifying. We were presented with one of those rare instances where a new technology could rewrite longstanding basic rules of the game. A subsequent presentation to the White House Science Council produced comparable enthusiasm for the NASP. Not surprisingly, over a period of several months the NASP--in particular, how to move it from a research to a development program--emerged as one of the highest priority issues in the White House Science Office.

The overriding importance of NASP is that it's a key to solving two critical problems that challenge America's future. One is the simple fact that the glory of our space program is fading, and we aren't likely to re-earn that glory through rhetoric or by clutching onto the technology of the past. Our current program offers big promises, but little inspiration.

Where Apollo challenged our American ingenuity, today's program mingles old technology with deja vu. But even those modest efforts are based on unrealistic, and in fact disproven, assumptions about our ability to provide access to space. Current space-lift capabilities and technology can't handle even today's demand, never mind those that would be imposed by a Space Station, new manned exploration, or defense needs. The NASP is the missing ingredient--the kind of technical challenge that drives innovation, and the new technology that can make access to space truly routine. And by truly routine, we mean at far lower cost and with much higher reliability than can ever be achieved with rockets. In addition, NASP is the pathway to the next generation of aircraft--an area of technology and industry that America still dominates but where current technology will, like the vacuum tube, become obsolete.

The second problem the NASP addresses is no less important--advanced manufacturing. These committees have heard much about the enormous promise of the new, composite materials. Our knowledge of those materials has progressed far beyond the fiberglas and carbon-fiber/epoxy composites in use today. But the overarching hurdle is how to manufacture them, in three dimensional structures. The NASP, initially under DARPA's visionary direction, and now as an excellent Air Force program, has become, in both industry and academia, a highly-focused, highly urgent challenge that has driven a remarkable degree of technological teamwork and technological progress. The NASP program is showing us the ways in which such teamwork can and should drive successful consortia, joint ventures, and university/industry/government partnerships. A national commitment to the NASP, of the kind we had had until this recent slowdown, can drive the emergence of real advantage for Americans. It will help our industries, first aerospace and defense, then commercial, master the technology of manufacturing advanced materials and become more competitive in world markets. But without such a commitment now, in future years we can expect to be hearing the same debate we hear today about automobiles and silicon over how the United States can compete with the advanced-manufacturing practices of other nations.

The NASP issue displays the fundamental difficulty America has in wrestling with technology policy. There's little argument or concern about America's science policy--one that was first articulated 40 years ago by Vannevar Bush, who pointed out the importance of federal support for basic research. But finding an effective technology policy, in today's climate, has proven far more difficult. Our technology policy, which was so effective for the first post-war generation, derived largely from meeting government's needs in space, health, and defense--and converting those technologies to commercial uses.

In many areas of technology that policy has been overtaken by events--notably the faster pace of innovation occurring in the commercial sector, especially in electronics. But in this area of aerospace technology, the old model remains very powerful and important. The NASP is exactly the kind of urgent government need, for next-generation access to space, that can also launch America into the lead in advanced manufacturing.

These, to us, are the real issues behind the debate over the NASP. It is far more encompassing than a debate over specific defense applications. One thing we can be sure of: The Pentagon's dependence upon space can only grow. No matter how U.S.-Soviet relations may calm and the need for new weapons systems change, the requirement for global surveillance and communications, based upon assets in space, will increase. And simply throwing more money at old technology, failing to deal with the fundamental problem of developing cheaper and more reliable access to space, is no solution. We believe the most important thing we can do at these hearings today is to call attention to that space role for the NASP as an urgent argument for restoring full funding--and unquestioned commitment--for the program to get it back on the fast track.

Dr. Keyworth and I recently published an article in Science magazine in which we referred to NASP as the enabler of the third generation of the space age. In the first generation we went to the moon and learned how to put large payloads in space. In the second generation we began to use space more broadly and to develop a commercial infrastructure as well. But in both cases we've come up against unforgiving physical limits. Those limits are imposed by conventional rocket technology. Conventional rockets, from the first boosters of the 1950s to the Shuttle boosters today, are heavily burdened by the requirement that they carry oxygen, as well as fuel, on board. That's a weight penalty that shows up in high launch costs, launch costs that limit the potential market. Moreover, the complexities and infrastructure for rocket boosters--launch pads, fueling, multi-day countdowns, etc.--are intimidating to the idea of routine access to space.

The chief attribute of the NASP is that it will, after half a century of little-changed rocket technology, greatly diminish those cost and flexibility constraints. Because the NASP is powered by engines that scoop oxygen out of the air it flies in, it will dramatically increase the payload ratio, and dramatically decrease the costs of putting those payloads in orbit. And because the NASP is an airplane, we expect it to extend airplane-like operational flexibility to space flight.

So, five years ago we were convinced that the prospects of a successful NASP were good, and that it would be so far-reaching that this little-known effort should become a high-priority national effort. In a relatively short time the NASP achieved that priority and became a major new technology development program. Moreover, the excellence that DARPA built into its early program has been carried forward into the development program. It has attracted some of America's best aeronautics and aerospace talent; it has stimulated substantial, new industrial investment in advanced materials and hypersonic aeronautics and produced remarkable results; it has developed innovative means of speeding research and sharing results among participants; and it has maintained and even extended the program's initial excitement as we get closer to what had been the 1990 goal of selecting the most promising approaches for actual prototype development. So it's ironic that, at a time when we're searching for a means to revitalize our troubled space program, we're on the verge of crippling this unique American tool for leadership.

Some recent reports have highlighted the risk involved in the program, suggesting that it's premature to enter into development. Let us just note that the risks are today better defined, more manageable, and less threatening than they were five years ago, even one year ago. The materials research has yielded a number of choices. The engine simulations are reassuring, indicating that very high mach numbers may be achieved in the air-breathing mode. Yes, there's a lot to do, and more to learn. But this technical challenge in no way rivals in sheer difficulty of the quest for an AIDS vaccine or, for that matter, the Apollo program. And those are, and were, like NASP, goals that could not be ignored.

Finally, let us re-emphasize the implications for national competitiveness, because we believe they are no less important. The United States has a very difficult time in mounting large-scale, long-term technology development programs, especially those programs in which government and commercial interests overlap, and especially those programs that require cooperation from organizations that are instinctively competitive. When we observe the speed and efficiency with which our major technology competitor, the Japanese, have organized broad, long-term R&D efforts in areas like superconductivity or high definition television, we are driven to anguished national self-examination about why we can't do that. Those and other recent examples have fed a growing worry about American technology policy. The Congress has devoted immense effort over the past few years to searching for effective--and appropriate--models for American technology development. We're looking, and experimenting, with dozens of possible approaches to stretch our investment horizons and pool scarce science and technology resources.

Yet here we're about to deemphasize the NASP program, one of the best of the few truly successful government-industry technology development partnerships, in an area where the United States probably has its best opportunity to emerge as the international leader, where its success will undergird our most successful technology export--aerospace. The past should be teaching us something here. Just one example--we look back at the American invention of videotape recorders and wish we had another chance, now, to develop the VCR technology in American companies. "If we could only have had more foresight!" we say. Yet here we are again, owning a clear-cut technological lead and getting ready to slow down and give our competitors a chance to catch up. We sense a truly disquieting sense of having been here before.

The market that we're talking about--aerospace, including commercial aviation--has a long and incredibly successful history of government providing the initial market for industry to develop the advanced technology, which it subsequently adapts for the commercial market. Defense--and in this case, space--provide an early, higher-risk market for advanced technology, and it's that early market that permits the necessary R&D to reduce new concepts to reliable practice. The current backlog of worldwide orders for U.S. commercial aircraft, exceeding 200 billion dollars right now, shows how economically powerful a lever that early government investment has been. And without question, the NASP program will lead to new-generation commercial aircraft. It's a unique opportunity for the government to stimulate continued U.S. leadership in 21st century aviation technology. It's hard to imagine a better way to ensure that those order books for U.S. aerospace companies remain backlogged for another generation.

Certainly if we're looking for an example of an effective kind of U.S. technology policy, the NASP seems made to order. There's no question about its legitimacy as a government program--the government is the initial customer for the products. And at the same time, the solution of the technical challenges, especially in advanced materials, will prove highly beneficial to U.S. industry in broad areas of application. Advanced materials, or more specifically, three-dimensionally engineered materials, whose properties are tailored to the specific structure they're a part of, are not only one of the most exciting areas of science and technology today, but an area where successes will have direct bearing on all manner of commercial manufacturing in the near future. The unique importance of the NASP program is that it gives engineers an application-driven test-bed to develop that next generation of materials. But to capture that benefit, we must have as an uninterrupted program goal the building of an aircraft. Without that focus, without that demand that systems perform under operational conditions, we're unlikely to reap the large benefits we've been expecting.

No one can come before the Congress and lay out a neat version of U.S. technology policy or industrial policy. More likely it will evolve, in stages, as we sort out the successful and unsuccessful attempts to form productive partnerships. NASP is one of the productive ones, and to let it be gutted now would be a disheartening message for America.

Mr. Chairman, that concludes Dr. Keyworth's and my testimony. Thank you for the opportunity to meet with you.

###

Mr. VALENTINE. Thank you, Mr. Abell.
Mr. Gaffney.

STATEMENT OF FRANK J. GAFFNEY, JR., DIRECTOR, CENTER FOR SECURITY POLICY

Mr. GAFFNEY. Mr. Chairman, thank you for permitting me to accompany people who know vastly more about the technical aspects of this program than I, and for whom I have the highest regard. And to whose strong recommendations about the need for this program, its technical feasibility and so on, I hope you will accord as much credence as I do.

I would ask your permission in addition to my formal statement being included in the record to have several other papers that the Center for Security Policy, which I direct, also be incorporated. These address both the larger direction of U.S. national space policy and the role of NASP in it. I will draw from these documents very briefly in my remarks this morning.

My feeling is that the critical issue for this Congress and for this administration to come to grips with is the priorities of its space program. We at the Center for Security Policy have identified a sort of three-part program: The first being to address the urgent requirement for an assured advantaged access to space as the immediate task.

The second is to address the desirable goal of extending and indeed expanding our exploitation of space through the pursuit of developments and deployments of new technologies over the near to medium term.

And finally, I emphasize thirdly, we should be worry about the exploration of space and the creation of requisite infrastructure for doing so.

We are very strongly persuaded that unless adequate resources and management attention are invested in the first of these; namely, the access-to-space problem, our ability to accomplish the latter two will be severely compromised. And in that sense I think the NASP Program, as a preeminent element of our effort to secure reliable, cost-effective access to space, must be regarded as a litmus test of the seriousness of the Bush administration—and, indeed, that of the United States about realizing the ambitious space program that the President so recently announced, involving, as you know, the manned base on the Moon and the exploration of Mars.

I personally believe that if we are unable to—perhaps more importantly, unwilling to—pursue the National Aero-Space Plane Program as a real and near-term program with immediate and tangible funding requirements, the skepticism with which many of you have greeted the longer term and more exotic elements of the President's space program would seem to me to be fully warranted.

I will not belabor points that have been made by my colleagues and that are certainly at least as familiar to members of these two committees as they are to me that require us to pursue the NASP Program. I would rather instead focus a little bit upon what I think is at work at the moment regarding NASP, particularly in light of what you heard from the previous panel, and a few comments, if I may, as to where I think we ought to go from here.

It is our view at the Center that the National Aero-Space Plane must become a high profile national program that is funded at a level determined by the maturity of the associated technology.

I do not believe that I have a disagreement with my friend Bill Graham on this, but I think when he says that this is a technology-driven program he means that it *was* a technology-driven program.

And what I would like to address with you here briefly is the issue that I think very many of you have already spoken to and that is that it is *not* a technology-driven program now—or it will not be if the Bush Administration has its way with its restructured program.

I personally am very much saddened by the decision that I think Dick Cheney had to make reluctantly to sharply reduce the contribution his department was to make in 1990 and to eliminate its commitment to the program in the future.

I, however, feel that that regrettable decision was understandable given his perspective on the funding available to his department, and I hope that those of you who are concerned with the situation with respect to NASP will address yourself to the larger problem that I think will become increasingly acute—namely, that of the inadequate funding for other Defense Department activities that ultimately prompted a hard choice to be made by Secretary Cheney on NASP. I think that explains part of his decision. And another part of it is obviously the outrageous and continuing practice of the Department of the Air Force in "gold-watching" this program.

I do not need to tell the members of this committee what that means. It is simply the practice of cutting a given program that is known to have national priority in a service's budget in the expectation that, as that budget is refined and finalized, others would add to the budget in order to restore its original funding level.

The effect of the Cheney decision has, I think, already been to have a deleterious impact upon industry's confidence in the future prospects of this program. And I agree with my colleagues who have emphasized how important that industry collaboration has been and will be to the ultimate success of this program.

It has also meant that the National Space Council, which has, as you know, to its credit resuscitated the NASP Program, was stuck with an unfortunate reality. It was behind the proverbial power curve. There was only so much that could be done under the circumstances confronting it. It was able to restore part of the earlier funding. It was able to oblige the Defense Department to reassume its share of the management responsibility but it did have to stretch out the develop schedule.

I am very much supportive of some aspects of this decision. Notably the decision to focus the effort on a research and development program involving the X-30 aircraft, and leaving the exploration of mission applications to a parallel but not pacing effort. But I am forced to conclude that as a result of these steps—the bureaucratic equivalents of the "perils of Pauline"—the NASP Program is simply no longer driven by technology and is instead being driven by the availability of funds.

And I will leave to my colleagues and to experts on this panel an argument about the technical state of these various component parts of the NASP Program and how they will be fitted together and so on.

But I must tell you that from the standpoint of a jaded policy practitioner with some time in grade both on the Senate staff and in the Pentagon, I find utterly unpersuasive Secretary Rice's contention that the mass restructured program is quote "progress driven."

For example, I am advised that the amount of money that was restored by the Air Force to this program as part of the restructuring activity happens to be exactly the amount of money that the Air Force had available to it for restoring these funds. That is to say, the amount of money that they could obtain and apply to this activity without having to go back into the bureaucratic budgetary trenches with other services or with the Office of the Secretary of Defense. That I believe smacks of a program that is fitting the availability of funds, not fitting the availability of technology.

I am frankly very much persuaded that the Congress has had an instrumental role in "walking the cat back," in keeping this program alive and getting it to the point where we can now debate whether this is an adequate level of funding, as opposed to it being self evident that we would not be able to pursue the program.

I think it is now up to you to determine whether the program will realize its potential: Whether it will be pursued in the efficient and timely way that our national security and other interests require.

I personally am of the view, and I think my colleagues at the Center for Security Policy are of the view, that a particularly important litmus test of your commitment and of whether this program will be moved along at the appropriate pace is whether the option is preserved for this aircraft to serve as a candidate for the follow-on to the shuttle. Under the present schedule, under the present developmental program, I think it is obvious that it will not be able to do that. And I think it would be a tragic mistake if we were to go through the process of investing still more funds in the next generation of shuttle-type systems and remain wedded unnecessarily to the vertical launch system and all of the inherent limitations of it.

Very quickly, Mr. Chairman, I would suggest five or six points that I think should be uppermost in your minds as you map out your strategy for moving the NASP along at the appropriate pace.

First, I think obviously it must be treated in a way that ensures the program is driven by the maturity of relevant technologies—not constrained by funding.

Second, I think that you should endorse, as indeed I think you have already, the National Space Council's efforts to concentrate on an X-vehicle and, importantly, to streamline the acquisition process that is one of the benefits of the decision that has come out.

By the same token however, I hope that you will block the effort now being made to ensure that the unmanned option is preserved in this X–30 aircraft. I am told that the only reason for that being included, and we can speculate about the role of the Rand Corporation which recommended that, by the way, played in all of this, but

I am told that there were some very petty bureaucratic reasons that underpinned it. And I hope that that will not be permitted to stand in the way of a more efficient, more cost-effective program.

I hope too that you will ensure that work on mission applications for this program will not fall by the way. I think if we are to have users identified and constituencies developed to move it from an interesting technology development effort into a real capability, that must go hand in hand—if not, again, as the pacing item, then at least as an element of the overall effort being made.

And finally I regret that Congressman Dellums had to leave. I would very much like to register the strongest possible opposition to his musing about the idea of having international collaboration brought into the development of this program.

You are all very familiar, of course, with the concerted effort being made by the technological competitors in both the free world and behind the iron curtain who would like nothing better than to have access to—and to rip off—the technology that we are so much advantaged in at this point.

The larger view that I think that we have at the Center for Security Policy is the idea of international cooperation in space is an abysmal one, period. But I think it is true in spades on this particular program given the vested interests—national security and commercial—of this country for generations to come that will be riding on the NASP Program.

Thank you, sir.

[The prepared statement of Mr. Gaffney follows:]

([illegible])

THE
CENTER
FOR
SECURITY
POLICY

2 August 1989

SUBMITTED TESTIMONY ON THE NATIONAL AEROSPACE PLANE
BY FRANK J. GAFFNEY, JR., DIRECTOR OF THE CENTER FOR SECURITY POLICY
BEFORE THE U.S. HOUSE OF REPRESENTATIVES COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

Introduction:

Mr. Chairman, Members of the Committee, it is a distinct privilege to be allowed to contribute once more to your deliberations about a major national issue, the National Aerospace Plane (NASP). I am especially pleased to be able to do so in the company of three old friends and distinguished experts on this issue -- Larry Skantz, Bill Graham and Bruce Abel. I know these gentlemen to be among the most knowledgeable authorities on the technical issues involved in this program. My own testimony will, I hope, complement theirs by focussing on some of the more significant policy aspects of the NASP program as they have developed in recent months.

In this regard, I would like to include in the record at the conclusion of my testimony not only the full text of my prepared remarks but also several papers concerning NASP that have been released recently by the Center for Security Policy. The first of these, entitled Defining a U.S. Space Policy: Getting from Here to There, summarizes the views of the Center's Board of Advisors and associates -- including Dr. George Keyworth and Gen. James Abrahamson -- about the "way ahead" for U.S. space policy and programs. You will note that we accord NASP the highest priority in this "road-map."

The second paper, called The Bush Administration Must Take the Initiative to Get the National Aerospace Plane off the Ground, builds upon the first and provides some insights into the machinations that went into the Administration's recent "high-G" maneuvers on NASP. I will draw upon both of these documents in my testimony this morning.

Getting Our Priorities Straight

The Center for Security Policy believes that U.S. space policy and programs should be guided by the following priorities:

o **Assured, advantaged access to space** must be the preeminent task for the immediate future.

1250 24th Street, N.W., Suite 600, Washington, D.C. 20037 (202) 466-0515 FAX (202) 466-0518

- **Extension and expanded exploitation of space** must be pursued through the development and deployment of new technology over the near- to medium-term.
- **Exploration of space and the creation of the requisite infrastructure** must be the longer-term goals of America's space program.

My sense is that this evolutionary strategy is roughly the same as that envisioned by President Bush's newly articulated space agenda. I want to emphasize, however, that we believe that -- unless adequate resources and management attention are invested in the first of these -- our ability to accomplish the latter two will be seriously compromised.

In that sense, the Bush Administration's commitment to the NASP program may be, and I believe should be, viewed as a litmus test of its seriousness about realizing the rest of its ambitious program for the space station, a manned base on the moon and the exploration of Mars. **If we are unable or unwilling to pursue the National Aerospace Plane -- a real and near-term program with immediate and tangible funding requirements -- the skepticism with which the longer-term, more exotic aspects of the Bush plan were greeted would seem fully warranted.**

The Necessity for NASP

Consistent with the Center's ordering of U.S. space policy requirements, we believe that the highest priority must be given to the development and operational fielding of the National Aerospace Plane. At the risk of preaching to the proverbial choir, given this Committee's extraordinary and unwavering support for the NASP and of repeating some of the points made by my colleagues, I would like to offer the following observations about why such priority seems to us to be warranted.

First, it is no overstatement to suggest that the NASP has the potential to revolutionize America's access to space, dramatically **reducing the costs, risks and inflexibility** inherent in current launch capabilities. We at the Center believe the United States can simply no longer afford to be wedded to the traditional means of putting payloads and people into space. The mind-boggling expense, the riskiness and the fragility of our existing space launch capabilies were hammered home to all of us in the aftermath of the Challenger explosion. An infrastructure with these characteristics cannot be expected reliably to support even a modest space program -- let alone the ambitious one mapped out by President Bush and the National Space Council.

Second, and related to the first, the National Aerospace Plane can contribute greatly to reestablishing U.S. preeminence in space, for civilian as well as military purposes. Today as never before, the United States faces strong competition for this position. It is not overstating the case to suggest that the technologies being explored in the NASP program are likely to be determinative of future comparative advantage in the aerospace industry.

What is more, in addition to its direct returns, NASP also will provide technological spin-offs of virtually incalculable value to other civilian and military applications. Its pathfinding research into materials, propulsion, computational, avionics and fuel technologies -- among others -- are essential to the future excellence of American industry in a variety of fields.

Finally, the reemergence of American primacy in space that the National Aerospace Plane represents will do much to restore popular and Congressional support for this vital area of national endeavor. It goes without saying that, during a period of budgetary austerity, such support may prove the difference between viable and unfunded programs. Furthermore, the value over time to this country of engendering the enthusiasm that attends an audacious and innovative undertaking of this kind is real -- if difficult to quantify. For example, as this Committee well knows, such programs have in the past stimulated great interest and enrollment in engineering and science programs, with long-term benefits for the nation.

Getting Serious About NASP

For these reasons, we at the Center for Security Policy are convinced that **the National Aerospace Plane must become a high profile, "national" program funded at a level determined by the maturity of the associated technology.** The recent history of the NASP program -- the bureaucratic equivalent of the perils of Pauline -- has shown, however, that, despite presidential interest in it, the aerospace plane has not enjoyed such priority thus far.

I very much regret the decision initially adopted by Secretary of Defense Dick Cheney to reduce the Defense Department's contribution to NASP in FY1990 and to eliminate it in subsequent years. His action was understandable, given the difficult budgetary pressures with which he is obliged to contend and the outrageous Air Force practice of "gold-watching" this program -- cutting it in the service's budget submissions in the expectation that others would restore its funds by adding to the Air Force's account.

The Defense Department's cut, nonetheless, signalled a critical lack of support for the program that has already had deleterious effects on industry's confidence in its future prospects. It also meant that, when the National Space Council -- to its credit -- resuscitated the program, the NASP was "behind the power curve:" the best that could be done was to restore part of its earlier funding, to oblige the Defense Department to reassume its share of the management responsibility and to stretch out the development schedule.

Thus, while I support the Space Council's decision to concentrate the NASP effort on research and development of the X-30, leaving exploration of mission applications to a parallel -- but not pacing -- effort, I profoundly regret the fact that the program is no longer driven by technology. Instead, it is driven by the availability of funds.

I will leave the arguments over the maturity of the technology and the level of risk associated with a more aggressive program to my technically competent colleagues. I would simply observe that -- from the standpoint of a jaded policy practitioner -- Secretary Rice's argument that the restructured NASP program is "progress driven" does not ring true. It is, for example, a fact that the amount of money restored to the aerospace plane after the program was resurrected is exactly the amount the Air Force could allocate without having to seek additional funds from the Office of the Secretary of Defense or its sister services. This smacks of development being paced by funding, not by "progress."

Where Do We Go From Here?

I applaud this Committee's strong advocacy of the National Aerospace Plane. I am convinced that your leadership helped to prevent the outright termination of the program. What is now up for grabs is whether the NASP will be permitted to realize its potential -- in the efficient and timely way our national security and interests require.

We at the Center for Security Policy believe it imperative that the technology involved in the NASP be pursued as vigorously as the state of the art will permit. Not the least reason for doing so is our belief that the aerospace plane can -- and must -- be available for consideration as a contender for the follow-on to the space shuttle. Unfortunately, it would appear that the restructured schedule, with its two and half year slip in reaching Phase III, will preclude such consideration.

In order to ensure that the NASP realizes its full potential, we would suggest the following steps be taken:

o Congress should stipulate that the aerospace plane be pursued on a schedule that is truly driven by the maturity of relevant technologies, not constrained by funding. Realization of this aircraft's potential must be seen as a litmus test of the Bush Administration's commitment to a real, rather than rhetorical, space program.

o Toward this end, the National Space Council's decisions to simplify the research task by concentrating on an X-vehicle and to streamline procurement procedures should be strongly endorsed.

o By the same token, however, the requirement to incorporate unmanned options into the X-30 design -- a requirement I understand was imposed for the most petty of bureaucratic reasons -- that will add to the cost and complexity of the vehicle should be eliminated.

o Congress should hold the executive branch's feet to the fire on development of the NASP by indicating that it expects the aerospace plane to be pursued in such a manner as to ensure that it can be a contender for the mission of follow-on to the shuttle.

o Strong support should also be given to efforts to identify and elaborate mission applications for the NASP. While such issues should not slow pursuit of the X-30 technology, it is imperative that work on missions and operational users be given priority -- if parallel -- attention.

- Finally, Congress should be very chary about the growing sentiment for international cooperation on space programs. This general observation is particularly true of the aerospace plane, whose technologies will be of such vital importance to U.S. security and commercial interests for generations to come.

Mr. **Valentine**. I thank all you gentlemen.

Let me say here that it is obvious and has been for a few minutes that we will not be able to get to the third panel and my apologies to Mr. Finley and those who are here with him. We would appreciate it—well, we will make your remarks a part of the record. But we have got to vacate the hall and there is no place else that we can go and I do, for Mr. Dellums and myself and other members of both subcommittees, apologize to you.

I want to leave most of what time we have left for my colleagues to pose questions and I think I know the answer to this, but I would just like to ask each of you if you can answer this question maybe in a word or two for the record beginning with Dr. Graham if you support—and like I say, I think I know your answers, but do you support a proposed 2½-year slip of the program, a 1-year slip, support the original schedule, or the acceleration of the schedule for 1 year?

Mr. **Graham**. Mr. Chairman, I believe that a 2½-year slip is too long. I think the fact that the RHYFL [1] hypersonic engine test facility at Rocketdyne should be coming on line in about a year warrants something not to exceed a 1-year lengthening of a design schedule for more experimental validation.

Again, this program should be, as my friend, Frank Gaffney, points out, a technology-driven program and the technology will finally choose the time scale. But my best guess right now is that if it is able to achieve the full funding level that was planned at the first of this year, then a one-year extension of the design process would be very productive and will probably not extend the program much by the beginning of flight test, because it will catch up in the full-scale design.

Mr. **Valentine**. General.

General **Skantz**. I would agree with Dr. Graham. I made the comment that I always regarded the X-vehicle decision date as a movable feast. And it ought to be technology driven.

My perception is, as Dr. Graham said, one year would be very beneficial. I think at some point, you know, the committee may want an independent assessment of just how well the technology is preceding because you have got a whole series of opinions and studies and briefings that give you anything from accelerated one year to delay at two and a half. And I think if I were sitting in your position I would sure like to get an independent assessment of whether or not it was technology driven, whether we were pursuing it at the right pace.

But I think that is the way we ought to go. And one of the things you ought to keep in mind, Mr. Chairman, is that the ultimate goal is single-stage-to-orbit and to get as far an atmospheric propulsion as you can before you get final injection.

There are some people who would in the instant of getting something flying would compromise with maybe not going too much beyond Mach 8 or Mach 12 in atmospheric propulsion and then adding in a big rocket engine phase which I think would be a terrible mistake. I think we ought not to lose the fundamental objective.

---

[1] RHYFL is the acronym for Rocketdyne Hypersonic Flow Laboratory.

Mr. **Valentine**. Mr. Abell.

Mr. **Abell**. I think probably as a result of what has happened over the past 4 or 5 months, we have already lost some time in any case.

I think what is important is that whatever action we take in terms of a schedule that we have a very strong and very visible and very believable commitment to as fast a program as we can possibly have. I think that the reactions in the industrial community have been very unfortunate but very understandable. And I think we really need to stress that we are moving as fast as we can in order to regenerate the kind of enthusiasm that has in turn driven this program.

Mr. **Valentine**. Thank you.

Mr. Gaffney.

Mr. **Gaffney**. Mr. Chairman, particularly as a neophyte in the technology, I would defer happily to my colleagues.

I think the point that Bruce has just made is the right one. That the signal ought to be that we are accelerating this program. The question of how fast we can do it or whether we can move it up at all is one that I would leave to others. And I think the idea of an independent look at this is a good one.

Mr. **Valentine**. Mr. Lewis, do you have any questions as ranking member of our subcommittee?

Mr. **Lewis**. Thank you, Mr. Chairman.

I think that some of the testimony that I have heard this morning just amplifies the need for the legislation for the National Aero-Space Plane.

Listening to the testimony and reading the testimony of these gentlemen it certainly points out the need for the National Aero-Space Plane.

I do not have a question, Mr. Chairman, but I would like to just point out to somebody from the Air Force, and I am sorry I could not do it during my time to take back to Secretary Rice. A good example is the SR-71 was an airframe and a propulsion system way ahead of its time and its technology was designed and developed as the airplane flew. And I think it is a good example to equate that to the National Aero-Space Plane. I have personal experiences with that so I do know what I am saying.

Mr. **Valentine**. Thank you, Mr. Lewis.

Mr. Walker.

Mr. **Walker**. Mr. Chairman, first of all I would ask unanimous consent for a couple of papers done on space policy and on the National Aero-Space Plane done by the Center for Security Policy be entered into the record.

Mr. **Valentine**. Without objection.

[The material referred to follows:]

[illegible])

THE
CENTER
FOR
SECURITY
POLICY

21 April 1989

DEFINING A U.S. SPACE POLICY: GETTING FROM HERE TO THERE

INTRODUCTION

With the establishment of the National Space Council, a tremendous opportunity now exists to consider anew America's near- and longer-term requirements for space. If successful, this reconsideration could result in: the wholesale reinvigoration of the United States' space policies and programs; a new organizational approach for their management; and the pursuit of activities compatible with lasting public -- and Congressional --support.

The following are recommended by the Center for Security Policy's Space Working Group as essential elements of the Space Council's agenda:

POLICY

o The Council should establish three overarching policy objectives for the United States space program:

-- Assured, advantaged access to space must be the preeminent task for the immediate future.

-- Extension and expanded exploitation of space must be pursued through the development and deployment of new technology over the near- to medium-term.

-- Exploration of space and the creation of the requisite infrastructure must be the longer-term goals of America's space program.

CIVILIAN PROGRAMS

In accordance with these policy priorities, the following programmatic initiatives should be emphasized by the National Space Council:

NASP

o Highest priority must be given to the development and operational fielding of the National Aerospace Plane (NASP).

-- This system has the potential to revolutionize America's access to space, dramatically reducing the

1250 24th Street, N.W., Suite 600, Washington, D.C. 20037 (202) 466-0515 FAX (202) 466-0518

costs, risks and inflexibility inherent in current launch capabilities.

- NASP also will provide tremendous technological spin-offs of virtually incalculable value to other civilian and military applications.
- NASP can provide as well a powerful means of reestablishing U.S. preeminence in space, a leadership position that will restore popular and Congressional support for this vital area of national endeavor.

o Obviously, the Defense Department's reported termination of any DOD role in NASP must be rejected.

o The National Space Council should, however, restructure this program, ending its status as a "black" or special access Air Force program, whose development pace is determined by that service's, at best, parsimonious allocation of funds.

- Instead, NASP should become a high profile, "national" program funded at a level determined by the maturity of the associated technology.
- If such a restructuring were effected, the goal of flying a DC-9 size NASP prototype by 1995 could be achievable.
- Given robust Japanese and European interest in developing aerospace plane technologies, such a level of effort is absolutely vital if the United States is not to lose its leadership position in this and related fields.

ELVs

o The urgent national need is for affordable, routine, frequent, flexible -- and, where appropriate, manned -- access to space.

- While NASP has the potential to provide a substantial contribution in this regard, there will be for the foreseeable future a requirement for a diversified, family of reliable, cost-effective Expendable Launch Vehicles (ELVs).

o It is a national scandal that America has been denied access to space for an extended period in the recent past; the United States cannot afford to repeat this dangerous situation in the future.

-- Consequently, the effort made over the past few years to reestablish and expand the infrastructure for producing and launching an array of ELVs should continue to receive high priority.

-- In particular, the program to develop and fly an affordable heavy-lift launch vehicle warrants the strong support of the National Space Council.

Space Technologies

o Concomitant support should be given to technologies that offer the potential of revolutionizing U.S. preeminence in and use of space.

-- Microminiaturization has the potential to transform such activities as data collection and transmission in space, opening remarkable new possibilities for smaller, less expensive, less vulnerable orbiting assets.

-- If properly exploited, Lightsats utilizing such technology can vastly increase the utility, survivability, and reconstitutability of both civilian and military satellite systems.

-- Similarly, direct broadcast satellites have the potential to enhance dramatically U.S. competitiveness in such fields as high definition television (HDTV) and international communications.

Space Station

o In light of the foregoing policy priorities, a different approach to meeting national needs for manned platforms in space seems in order.

-- Instead of moving directly toward the highly sophisticated, enormously expensive Space Station now envisioned by NASA, the Space Council should charter an interim step, one that would offer near-term insights into the challenges of extended missions in space and permit evolutionary progress toward more ambitious structures.

-- This approach would take advantage of available shuttle-based technology, namely a modified, free-flying SpaceLab.

o The experience gained from such an approach would enable appropriate changes to be made in the configuration, orbit and missions of the Space Station without further postponing the necessary reestablishment of an extended American presence in space.

MILITARY PROGRAMS

The genius of the Space Council's mandate is that it explicitly envisions unified oversight of the civilian and military facets of the U.S. space program. By approaching the related technical, logistical and programmatic aspects of space in a coherent fashion, it should be possible to realize significant economies of scale and to reduce unnecessary, wasteful duplication.

Specific military programs warrant the Space Council's strong support:

SDI

- The Strategic Defense Initiative represents a vital element of the United States' future security posture. Its strategic benefits will be maximized by the introduction of robust, effective space sensor and weapons elements. The Space Council should strongly encourage the vigorous pursuit and expeditious deployment of such defensive systems.

ASAT

- The United States has an urgent requirement to neutralize hostile space satellites and to defend its own. At present, America has no such capability.
- By contrast, the Soviet Union has developed, tested and deployed myriad systems with the inherent ability to attack U.S. assets in space.
- Particularly in the absence of the sort of proliferated, survivable, and rapidly reconstitutable satellite capabilities called for above, the United States is in serious jeopardy of having its peacetime command, control, communications and intelligence system severely degraded in time of crisis or conflict.

COMMERCIAL SPACE ACTIVITIES

The National Space Council should also place high priority on the stimulus the federal government can provide to the establishment of healthy and competitive commercial space launch and service industries.

- The Space Council must, in particular, ensure that a climate is created in which indigenous commercial space launch capabilities can be created and grow.
  - To this end, it should oppose future proposals providing for the launch of American satellites aboard launch vehicles of non-allied nations.
  - In particular, for commercial and national security reasons, the United States should continue its policy of prohibiting U.S. satellite launches aboard Soviet vehicles.
  - The Space Council should also seek a fair-pricing agreement with the allied launch services community to assure genuine competition for American companies.

U.S.-SOVIET SPACE VENTURES

Both because exploration of space should enjoy lower priority in terms of near- to medium-term demands on U.S. space resources and for sound national security and technology transfer reasons, bilateral space ventures with the Soviets should be kept to a minimum. Specifically, ventures like a joint mission to Mars should be explicitly precluded.

The Center for Security Policy is a not-for-profit, non-partisan educational corporation established in 1988. It exists to assist those in the executive and legislative branches of the United States government, in the press and among the general public concerned with foreign and defense issues in promptly understanding and addressing strategically significant security developments.

THE BOARD OF ADVISORS

Elliot Abrams
Rachel Abrams
Morris J. Amitay
Robert Andrews
Frank Barnett
Linden Blue
Stephen D. Bryen
Beverly B. Byron
Steven Carter
Tom Clancy
Jim Courter
J.D. Crouch
Mitchell E. Daniels
Midge Decter
Ken DeGraffenreid
John Duncan
Jon Englund
Charles Fairbanks
Mark Falcoff
Douglas J. Feith
Edwin J. Feulner, Jr.
Frank J. Gaffney, Jr.
Patrick Glynn
Andrew Goldman
Margaret Graham
Colin S. Gray
Nancy D. Greene
James T. Hackett
DeForest A. Hamilton
Amoretta M. Hoeber
Marc L. Holtzman
Henry J. Hyde
Fred C. Ikle
Jamie Jameson
Alan L. Keyes
George A. Keyworth II
Jeane J. Kirkpatrick
Sven F. Kraemer
Charles Kupperman
Jon Kyl
John Lenczowski
James C. McCrery
Bob McEwen
Kinnaird R. McKee
Philip Merrill
J. W. Middendorf III
Michael H. Mobbs
Josh Muravchik
Keith B. Payne
Amos Perlmutter
Richard Perle
Robert R. Reilly
Roger W. Robinson, Jr
James Roche
William Schneider, Jr
Bernard Schriever
James Sherr
Abram Shulsky
Max Singer
Jed Snyder
Henry Sokolski
Rob Soofer
Herbert Stein
Richard G. Stilwell
Howard R. Teicher
Edward Teller
William Van Cleave
Michelle Van Cleave
Malcolm Wallop
James H. Webb, Jr.
Michael L. Weinstein
Seymour Weiss
Curt Weldon
Faith Whittlesey
Pete Wilson
Curtin Winsor, Jr.
James L. Wolbarsht
Dov S. Zakheim

The Center's working paper on U.S. space policy is one of a series of occasional contributions by the Center for Security Policy to the national debate on foreign policy and defense issues. Such contributions are intended to invigorate and enrich that debate; they do not necessarily reflect the views of all members of the Center's Board of Advisors. For more information about these papers or other work of the Center, please contact the Director, Frank J. Gaffney, Jr.

Mr. WALKER. And I just want to clarify for the record, if I understood all of you in response to the Chairman's question, there are none of you who believe that a 2½ year delay is necessitated by technological problems at the present time, is that right?

Everybody is shaking their head yes. I want it reflected for the record that the explanation that we got, the 2½ year delay because of technical reasons is not shared by a group of people that have one of the broader views of this program that I think exists in the country.

Thank you, Mr. Chairman.

Mr. GAFFNEY. Mr. Walker, may I just add to that.

Mr. WALKER. Sure.

Mr. GAFFNEY. We had an opportunity recently to have a session with representatives of the National Space Council and one of the messages that came across very clearly in that conversation was that despite some of the language that you heard this morning and indeed language that is even in the President's press release about NASP, about technology problems or technologies uncertainties, the issue for the National Space Council was funding. And the reason that it came out where it did and the impact on the program is what it is, is because of funding.

Mr. WALKER. And the message there is if we come up with adequate funding, they should be able to fund a far better schedule and a far better program and yet their testimony here today is they would reprogram the money. Now, I mean that just does not fit.

Mr. GAFFNEY. Again, I think what you saw, and I thought your colloquy with Secretary Rice pointed this out very well, that the problem really is, as far as I can tell, the ultimate problem that persists in the Defense Department and indeed elsewhere about "national" programs. If it has to come out of their money, it is a problem.

Mr. VALENTINE. We are just smack out of time.

And in deference to Mr. Lewis, I do not know whether we can do this or not, but we will try. But he had one question he wanted to ask Mr. Finley, and I do not want to shoot anybody in the grass or anything, but we will try this as we depart.

I understand the next show is outside waiting in the wings, but, Mr. Finley.

Mr. LEWIS. Mr. Finley, just for the record, I want to ask you, in your studies could you tell the committee how we stand in our position with others as far as the development of a aerospace plane type of vehicle in relation, say, to the Soviet Union, West Germany, and others?

Mr. FINLEY. I think that two important indicators that the GAO found that showed us the most are the amount of funding and the number of people involved. For example, the U.S. Government and industry have invested about $1½ billion in the NASP Program. The European countries and Japan together have invested about one quarter of a billion dollars, with about $200 million of that coming from Japan. When you look at folks associated with the program, there are over 5,000 working on the NASP Program in government, industry, and universities. In Europe and Japan, there are only a few hundred.

Mr. Lewis. How does this compare with like the Sänger II and others where they are making commitments of 5 years? Does your research show that we could slip behind them from the position that we are in at this point?

Mr. Finley. There is no question that unless we continue the pace we are on that we will not be as far ahead in the near future as we had projected.

Mr. Lewis. Thank you. That answered my question, Mr. Chairman.

[The prepared statement of Mr. Finley follows:]

United States General Accounting Office

GAO

Testimony

For Release
on Delivery
Expected at
9:30 a.m. EST
Wednesday
August 2, 1989

Investment in Foreign Aerospace Vehicle Research and Technological Development Efforts

Statement of
Harry R. Finley, Director, Air Force Issues
National Security and International Affairs
Division

Before the
Subcommittee on Transportation, Aviation, and
Materials
Committee on Science, Space, and Technology
and the Subcommittee on Research and Development
Committee on Armed Services
House of Representatives

GAO/T-NSIAD-89-43

GAO Form 160 (12/87)

Chairman Valentine, Chairman Dellums, and Members of the Subcommittees:

I am pleased to be here today to discuss the preliminary results of our review of foreign aerospace investment.

In our April 1988 report, National Aero-Space Plane: A Technology Development and Demonstration Program to Build the X-30 (GAO/NSIAD-88-122, Apr. 27, 1988), we concluded that the $3.3 billion National Aero-Space Plane (NASP) Program is technologically challenging and a high-risk program. However, the potential payoffs are also high. We noted that although the program's schedule and milestones may ultimately be achievable, they are ambitious and leave little room to accommodate potential design and integration problems or test failures. If any one of the enabling technologies does not mature as quickly as expected, the entire program could be delayed. We also reported that the United Kingdom, France, West Germany, the Soviet Union, and Japan are each developing technologies for their own concept of an operational aerospace plane.

As a result, the Chairman of the House Committee on Science, Space, and Technology asked us to collect information on foreign government and industry investment in aerospace vehicle research and technological development efforts. Our review included France, West Germany, the United Kingdom, the Soviet Union, and Japan, since each of these countries is developing technologies for various concepts of operational aerospace vehicles. In addition, we obtained information on aerospace test facilities (such as wind tunnels) in the Netherlands, Belgium, Italy, and Australia. Although these countries do not have national programs to develop and build air-breathing aerospace vehicles, their test facilities are being used to conduct research and development of such vehicles.

During our review work in Europe, Japan, and Australia, we met with U.S. Embassy; international organization; and foreign government, industry, and university officials to obtain information on aerospace goals and objectives, current aerospace vehicle programs, technological challenges, government and industry funding, test facilities, future air-breathing aerospace vehicle efforts, and prospects for international cooperation. We also visited key test facilities (such as wind tunnels; shock tunnels; air-breathing propulsion test cells; advanced materials research, development, production, and fabrication laboratories; and supercomputer facilities) in each country. We are presently analyzing the information. At this point I would like to summarize our preliminary observations regarding Europe, Japan, and Australia. Since we have not progressed far enough on our assessment of aerospace investment in the Soviet Union, we are not including the Soviet Union in our preliminary observations.

PRELIMINARY OBSERVATIONS

We found the following.

-- Foreign countries are developing the technologies needed for various concepts of operational aerospace vehicles to secure independent access to space, reduce the costs of launching payloads into orbit, and ensure a competitive role in future high-speed commercial transport markets.

-- No European or Japanese aerospace technology development program is as technologically challenging as the NASP Program in terms of a single-stage-to-orbit space launch capability and an air-breathing propulsion system using a supersonic combustion ramjet (scramjet). No European or Japanese program compares to the scope of the NASP Program. However, foreign countries are making progress in the development of enabling technologies (particularly in advanced propulsion and advanced materials).

-- No European country or Japan has officially approved any plan to build a spaceplane. The United States also has not approved such a plan. Foreign aerospace vehicle programs are concept or system studies and consist of fundamental research on enabling technologies.

-- Levels of investment in aerospace vehicle research and technological development by European and Japanese governments and industry to date are significantly less than U.S. government and industry investment in the NASP Program. Planned U.S. government and industry funding levels also appear to be substantially greater than planned European and Japanese government and industry funding levels.

-- According to foreign government officials and industry representatives, test facilities (such as wind tunnels and air-breathing propulsion test cells) are adequate for fundamental research and the current level of effort in Europe and Japan, but the facilities are not adequate for large-scale testing or development of a spaceplane.

-- No European country or Japan appears likely to develop and build a spaceplane by itself because of the extensive technology and funding requirements. Building a future European spaceplane will probably be an international effort, most likely under the European Space Agency (ESA). Any future Japanese spaceplane will also probably be an international effort.

-- Foreign government officials and industry representatives expressed interest in cooperating with the United States on the NASP Program, but they also expressed reservations about cooperative ventures with the United States. These include their past experiences with the United States in other programs (such as the planned U.S. space station), the perception that NASP is a military program, potential military applications of a future NASP-derived operational vehicle, a reluctance by the United States to share its technology, strict U.S. export controls on the transfer of technology, and Japanese constitutional prohibitions against the military use of space. According to U.S. government and industry officials, areas in which foreign technology might be incorporated in the NASP Program include advanced propulsion and advanced materials as well as the use of foreign test facilities.

Let me now summarize our principal findings by country.

FRANCE

The Hermes spaceplane program, originally a French national program, was adopted by ESA. Hermes is being developed as a manned reusable shuttle-like reentry winged vehicle, which would not use an air-breathing propulsion system. Hermes would be launched by the Ariane 5 rocket booster, also under development, from ESA's Kourou Space Center in French Guiana. According to an ESA official, Hermes development costs are expected to total about $5 billion. French space agency officials told us that France plans to contribute approximately 45 percent of the $605 million Phase I (1988 to 1990) development cost. According to ESA and

French government officials, ESA plans to review the Hermes program before committing funds for Phase II development (1991 to 1998). Until Hermes becomes operational, France does not plan to develop an air-breathing aerospace vehicle.

According to French government officials, the French space agency provided about $10 million for a low-level, 3-year concept study (1986 to 1988) to assess various spaceplane concepts and technological requirements. These officials indicated that the French space agency may provide an additional $3 million to $4 million in 1989 to extend this technical evaluation by 1 year. In 1989 or 1990 France may decide on an initial 3-year (1990 to 1992) technology maturation program for an air-breathing aerospace vehicle--as long as it does not interfere with Hermes' budget.

As part of the French space agency's 3-year concept study, Avions Marcel Dassault-Breguet Aviation conducted a system study, known as STAR-H, to identify the most promising concepts and most critical technologies for a future air-breathing transportation system. STAR-H is not a spaceplane project, but rather an effort to build a reliable database. Aerospatiale also conducted a concept study of reusable space transportation systems called STS-2000. Two French propulsion companies and the National Office for Aerospace Studies and Research are currently conducting propulsion studies. French propulsion firms do not plan to begin evaluation of a scramjet until 1990.

FEDERAL REPUBLIC OF GERMANY

The West German Federal Ministry for Research and Technology provided about $8.5 million between 1982 and 1987 to conduct concept studies of a spaceplane. In 1988 West Germany initiated a Hypersonic Technology Program funded by the Federal Ministry for Research and Technology, which involves Dornier, Messerschmitt-Boelkow-Blohm (MBB), and Motoren- und Turbinen-Union. Phase I (1988 to 1992) is a West German national effort consisting of conceptual and technology studies. Phase II (1993 to 2000) will be an international effort to develop a flight demonstrator. Phase III (2001 to 2005) will involve flight tests of the demonstrator. MBB's Sanger II, a two-stage-to-orbit space launch vehicle using an air-breathing turboramjet, is the leading concept. West German officials hope that Sanger II will be adopted by ESA as a follow-on program to Hermes.

Phase I is expected to cost about $233 million, of which $174 million has been obligated. West German government officials said the Federal Ministry for Research and Technology plans to contribute about $125 million, and the German Aerospace Research Establishment, also a government agency, plans to provide about $49 million by 1992.

Universities in West Germany are also conducting research in hypersonics in a project coordinated with and complementary to the Hypersonic Technology Program.

West Germany is not considering scramjet propulsion because it is too expensive and too technologically challenging. West German industry representatives believe a two-stage-to-orbit vehicle using a turboramjet is the most efficient aerospace vehicle concept.

THE UNITED KINGDOM

The United Kingdom is also not developing an air-breathing aerospace vehicle. However, British Aerospace and Rolls-Royce are developing the Horizontal Takeoff and Landing (HOTOL) unmanned single-stage-to-orbit, fully recoverable, and reusable space launch vehicle. HOTOL would be launched by a rocket-powered wheeled-trolley or sled from a conventional runway. The British government believes industry should take the lead in conducting research and development of an aerospace vehicle.

The British National Space Centre funded a $3 million, 2-year (1986 to 1987) evaluation to prove the feasibility of HOTOL, but it withdrew all government funding for HOTOL as a British national program in 1988, citing HOTOL's cost and the need for international partners. The United Kingdom also withdrew its funding for ESA's Hermes spaceplane and Ariane 5 rocket booster programs because of their costs. British space officials told us that they promised to reevaluate their participation in the HOTOL project in 1991 or 1992 "in a properly organized international venture" but stated that this is not a promise of renewed funding. British Aerospace is trying to obtain private funding within the United Kingdom and exploring opportunities for international cooperation in Europe and the United States.

JAPAN

Japan's objectives are to become a central player in world space development by establishing manned, permanent facilities in space and developing a space transport system. Japan does not have an established national research development plan to build a spaceplane. However, a coordinated advanced research effort by the Japanese government is being conducted on enabling technologies. The National Space Development Agency of Japan is developing a reusable, re-entry winged vehicle known as the H-II Orbiting Plane (HOPE), which will serve both as a technology demonstrator and operational vehicle. The Institute for Space and Astronautical Science is developing a reusable, single-stage, unmanned ballistic flight test vehicle called the Highly Maneuverable Experimental Space (HIMES) vehicle. This vehicle will serve as a recoverable sounding rocket and as a test bed for hypersonic flight and air-breathing engines. The National Aerospace Laboratory is conducting fundamental research on single-stage-to-orbit and two-stage-to-orbit spaceplane concepts.

Japanese Ministry of International Trade and Industry officials estimate that all Japanese spaceplane activities over the next 15 years could total $2.34 billion to $3.12 billion. According to Japanese government and industry officials, test facilities in Japan are adequate for fundamental research but not for large-scale testing or development of a spaceplane. To increase their expertise, Japanese officials said that they duplicate past U.S. tests to gain experience in hypersonics.

Japanese officials view spaceplane development as an international effort and are primarily interested in cooperating with the United States. However, Japan wants to raise its technology level to international standards first. According to U.S. government and industry officials, potential areas for international collaboration are in advanced propulsion and advanced materials.

AUSTRALIA

Australia is developing expertise in selected subsystems for air-breathing aerospace vehicles. Australia has unique test facilities--the T-3 and T-4 shock tunnels--that have the capability to simulate actual flight conditions above Mach 5. The T-4 shock tunnel was built specifically to test scramjets. These facilities are currently being used to test the United Kingdom's HOTOL, ESA's Hermes, West Germany's Sanger II, and scramjet combustion mixing for the National Aeronautics and Space Administration. The Australian government and industry funded a 15-month feasibility study of the proposed Cape York Spaceport, which will accommodate future spaceplanes. A consortium of business interests in Australia, the United States, and Japan recently announced that the international spaceport was "commercially viable" and that it plans to proceed with the project as soon as possible.

Over the next several months, we plan to issue a series of reports on aerospace investment in foreign countries. Our draft report on Foreign Aerospace Investment: Technical Data and Information on Test Facilities has been sent to agencies for comments. Subsequent reports will address aerospace investment in France, West Germany, the United Kingdom, Italy, the Soviet Union, Japan, and Australia, and our overall evaluation and conclusions.

This concludes my prepared testimony. We will be pleased to respond to any questions you may have.

Mr. Valentine. Thank you very much. Thank all of you very much for appearing and the subcommittees stand adjourned.

[Whereupon, at 1:02 p.m., the subcommittees were adjourned.]

APPENDIX

TESTIMONY OF ANTHONY A. DUPONT

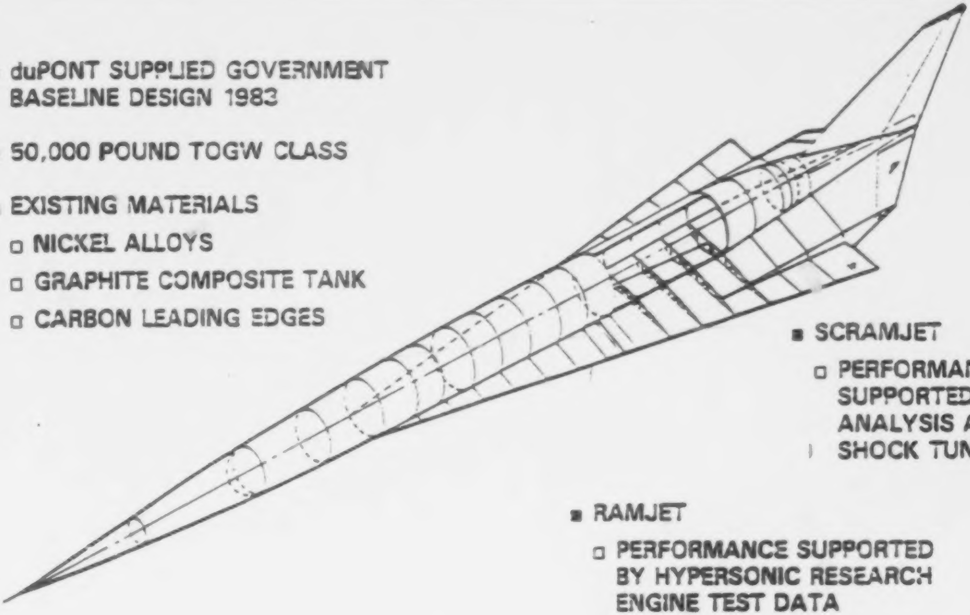
PRESIDENT, DUPONT AEROSPACE COMPANY, INC.

1.0 ORIGINS OF NASP

NASP originated from an unsolicited proposal from our company submitted to DARPA in late 1982. On April 1, 1983, I briefed Dr. Bob Cooper, head of DARPA. Shortly afterwards Bob Williams was assigned as the DARPA program manager. We completed a $30,000 initial study by October 1983. The answer to DARPA's question posed by Bob Williams: "What is the smallest airplane which will demonstrate the single stage to orbit airplane technology?" is shown in Figure 1. It is a 50,000 pound airplane built of existing materials which fully meets the original NASP problem statement: single stage to polar orbit with flight test instrumentation and with the capability of making a go around after refusing a landing. This airplane and its engine were documented by our company and used as the point of departure for the major contractors brought into the initial program by DARPA in 1984. It was called the Government Baseline Airplane and Engine.

The low speed engine cycle developed by our company was tested at the General Applied Science laboratories, GASL, in 1984, 1985 and 1986. It was demonstrated to General Skantze, then the commander of AFSC in August of 1985. General Skantze strongly supported the program as a result of the test data and other material presented at that time. Of particular importance was the

NASP



- ■ duPONT SUPPLIED GOVERNMENT BASELINE DESIGN 1983
- ■ 50,000 POUND TOGW CLASS
- ■ EXISTING MATERIALS
  - ☐ NICKEL ALLOYS
  - ☐ GRAPHITE COMPOSITE TANK
  - ☐ CARBON LEADING EDGES
- ■ DRAG LEVEL VERIFIED
  - ☐ NASA WIND TUNNEL TESTS
  - ☐ BOEING SUPPLIED MODEL
- ■ SCRAMJET
  - ☐ PERFORMANCE SUPPORTED BY ANALYSIS AND SHOCK TUNNEL
- ■ RAMJET
  - ☐ PERFORMANCE SUPPORTED BY HYPERSONIC RESEARCH ENGINE TEST DATA
- ■ ACCELERATION ENGINE
  - ☐ DESIGN BY duPONT
  - ☐ PERFORMANCE VERIFIED BY GASL AND PW TESTS

duPONT AEROSPACE COMPANY, INC.

Figure 1

"nose to tail" analysis of engine performance at orbital speeds, which showed potential performance at this speed well in excess of rocket engines.

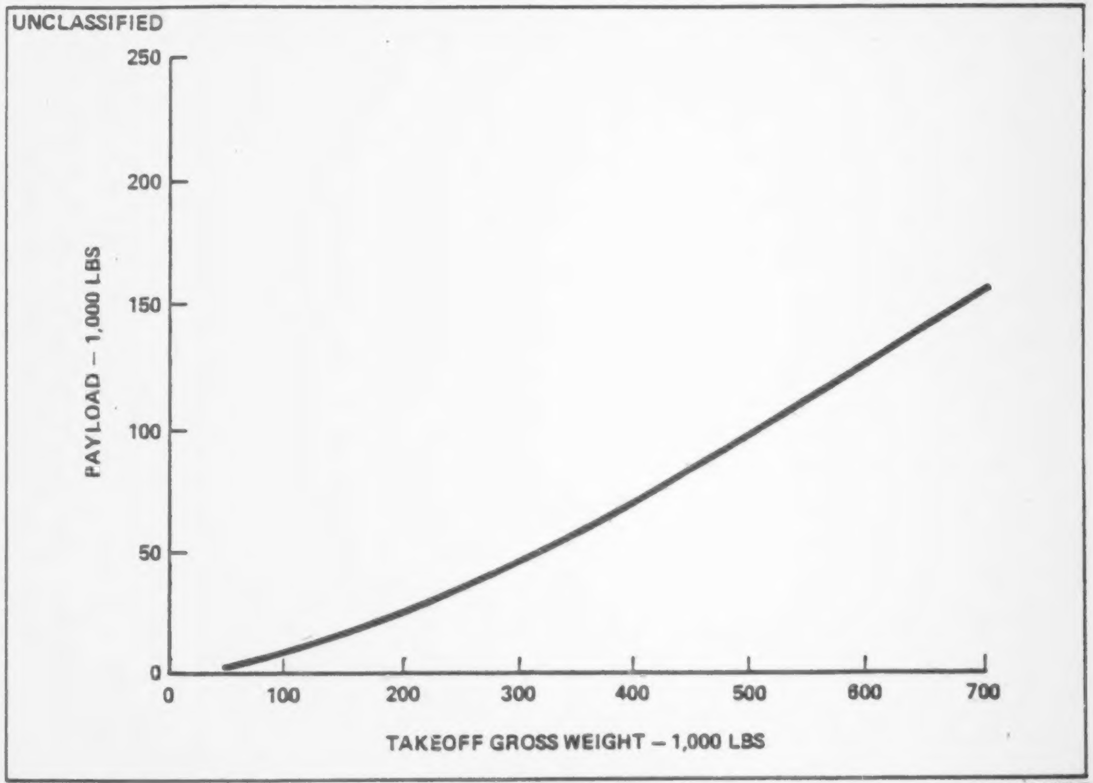
General Skantze and the DARPA management decided to make the development of this engine and the experimental aircraft that would be built to flight test it a national program involving the Air Force, Navy, SDI and NASA, all of which contributed funding to the program. Industry at this time also committed large portions of the initial funding. We, for example, had supported work on this airplane and engine continuously from 1972 to 1983 without government support in order to provide the technical basis for the program.

As the program has matured, virtually all the initial estimates that support the performance of the Government Baseline airplane and engine have been verified by NASA and contractor activities. Some of the most important milestones are noted on the chart, such as the NASA wind tunnel tests of the configuration using models supplied by the Boeing Military Airplane Company and the high speed combustor tests at CALSPAN.

The potential of an airplane design which meets the original NASP problem statement with a gross weight of 50,000 pounds is shown in Figure 2, which is a plot of payload versus takeoff gross weight. From this chart it can be seen that an airplane only a little larger than a DC-9 or 737 can carry the same payload as the Space Shuttle and a 700,000 pound airplane, in the 747 size range, can carry 150,000 pounds. This size versus payload capability

UNCLASSIFIED

PAYLOAD VS. SIZE – 150 Nautical Mile Polar Orbit (U)



duPONT AEROSPACE COMPANY, INC.

UNCLASSIFIED

Figure 2

combined with the airplane mode of operation offers the potential to reduce the cost of space transportation by a factor of nearly 100.

2.0 PRESENT POSITION

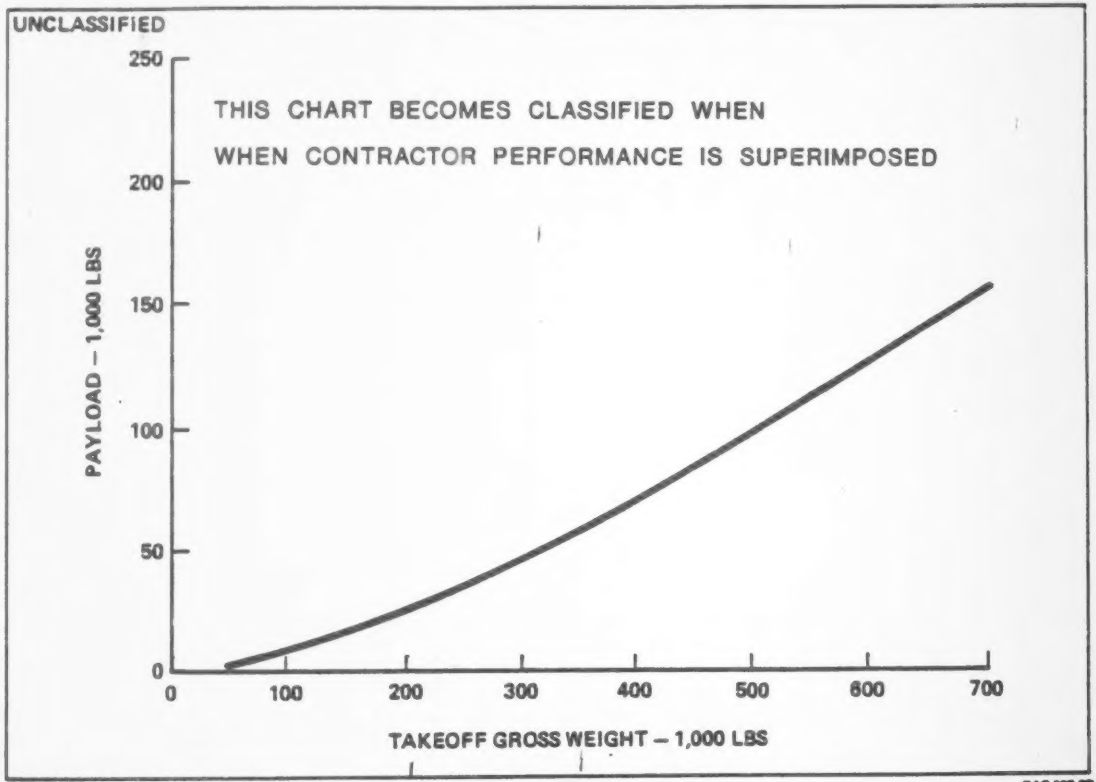
The present position of the program is not what we expected. The contractor performance presented at the latest review is way below the original Government Baseline payload versus takeoff gross weight trend. The initial assumption made by the Department of Defense that the large industrial corporations with funding in the hundreds of millions would quickly arrive at a solution superior to the Government Baseline has not been proven by subsequent events. Later on in my testimony I will explain in more detail some of the reasons for this. At this point I will just summarize by saying that it was not possible to transmit 30 years of engineering experience in a few two-hour briefings to an audience who shared the belief that they would quickly be able to do better.

Only one of the contractor designs has the potential to live up to the early expectations for the program. This is the airplane which is closest to the Government Baseline in both the engine and airplane configuration. It has a drag level and therefore an engine size approximately one half of the other airplanes, and it uses airbreathing propulsion all the way to orbit.

The airplanes which use rocket propulsion above approximately half way to orbital speed are way below the expected trend in

UNCLASSIFIED

PAYLOAD VS. SIZE – 150 Nautical Mile Polar Orbit (U)



duPONT AEROSPACE COMPANY, INC.

DAC-[illegible]-23

UNCLASSIFIED

Figure 3

payload capability. In addition, they require the achievement of an empty weight fraction about 30% to 50% less than the best current aircraft and less than any other aircraft has ever achieved except possibly the Voyager which Burt Rutan designed to circumnavigate the world nonstop. The Voyager, it must be pointed out, operates at room temperature and was fueled by gasoline with a density of 50 pounds per cubic foot. The NASP is fueled by liquid hydrogen at a density of 4.4 pounds per cubic foot and has an average surface temperature during ascent of around 1,600 degrees fahrenheit.

By using a rocket above a little over half of orbital speed two out of the three contractors are ducking the issue that NASP was supposed to resolve: namely the capability of airbreathing engines up to orbital speeds. This not only represents a philosophical departure from the original goals of the X-30 program, but has resulted in poor projected performance and unrealistic weight estimates.

A difference between the Government Baseline and the contractors' efforts is that they all rely heavily on advanced materials which greatly increases the cost and uncertainty of the program. Extensive use in the contractors' designs of "wishalloy" and "unobtainium" has made the aircraft and engine development dependent on progress in some very difficult and costly material development programs. Our own position is that good design can meet NASP objectives with existing, well proven high temperature materials. An example is a fuselage panel shown in Figure 4 which we manufactured to show that large vacuum tight panels could be made from nickel alloy in thin gages. This panel weighs one pound per square foot and is strong enough to meet NASP objectives. I have brought a couple of samples of this material, inconel honeycomb sandwich, which I will pass around. This material is used to shroud the Space Shuttle main engines, in the Concorde tail pipe and thrust reverser and in the 757 and 767 engine nozzles.

Another example is the Hypersonic Research Engine, HRE, which I and some of our engineers built for the X-15 while we worked for the Garrett AiResearch Corporation. A picture of this engine mounted on the X-15 is shown in Figure 5. After the X-15 was grounded the engine was tested in ground facilities as shown in Figure 6. Lee Anderson, one of our senior development engineers, is in the test cell with the engine. I have with me a small sample of the cooling fins used in this engine which I will pass around. The configuration of these fins is shown in Figure 7. In the region from Mach 4 to 7 where the HRE was tested the test data was used to set the level of Government Baseline performance as shown in Figure 8. The HRE, the only flight type Supersonic Combustion Ramjet, SCRAMJET, built to date was built and tested in the late 1960s and early 1970s for a total cost, contractor and government, of $40 million. The first flight type engine was shipped to NASA less than three years from the start of the hardware phase of the contract. With the exception of the low speed acceleration cycle, this was an engine that met most of the NASP engine requirements. The weight of the Government Baseline engine is based on the actual

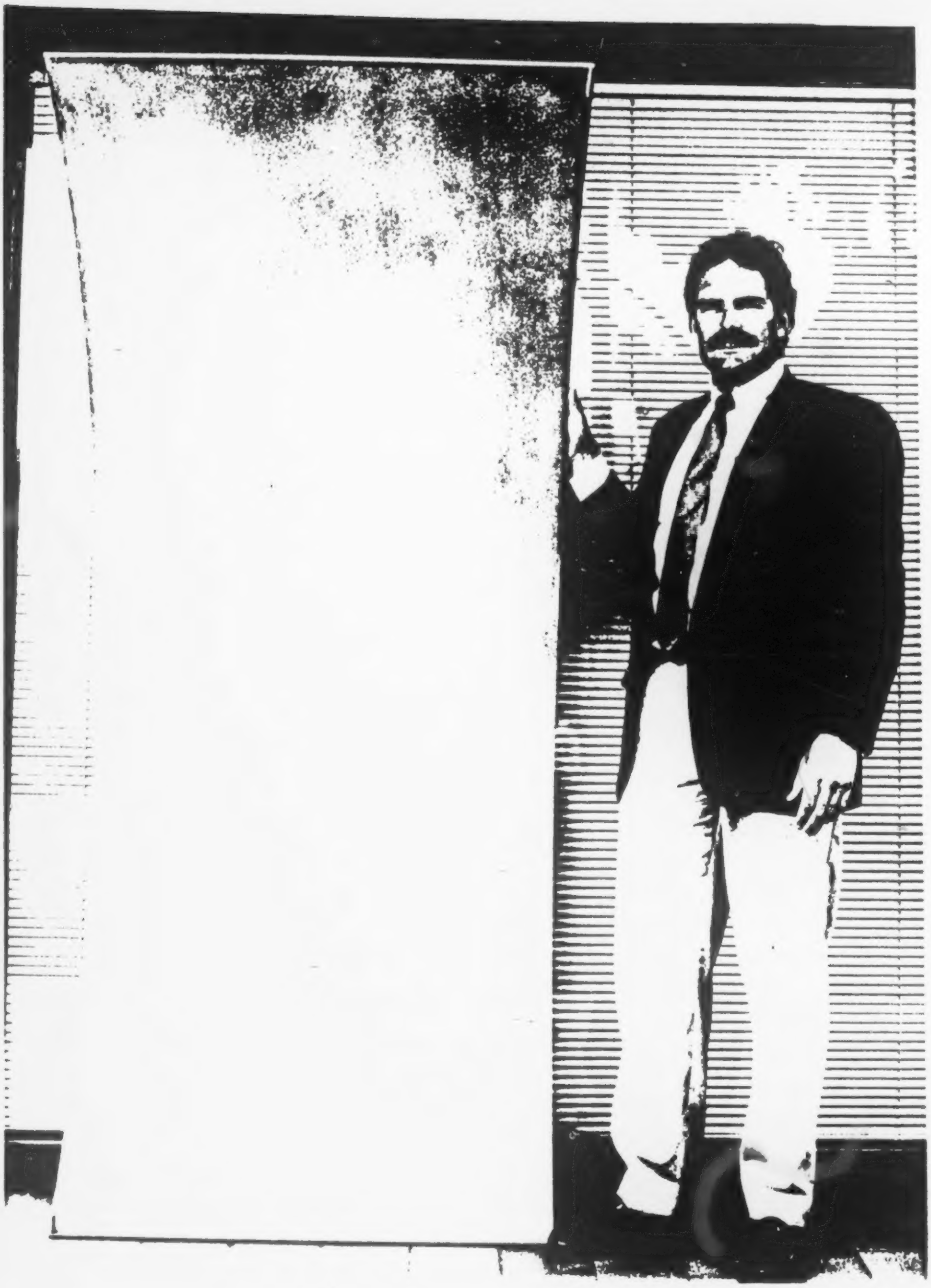


Figure 4

THE MODIFIED X-15A-2 ROCKET RESEARCH AIRCRAFT

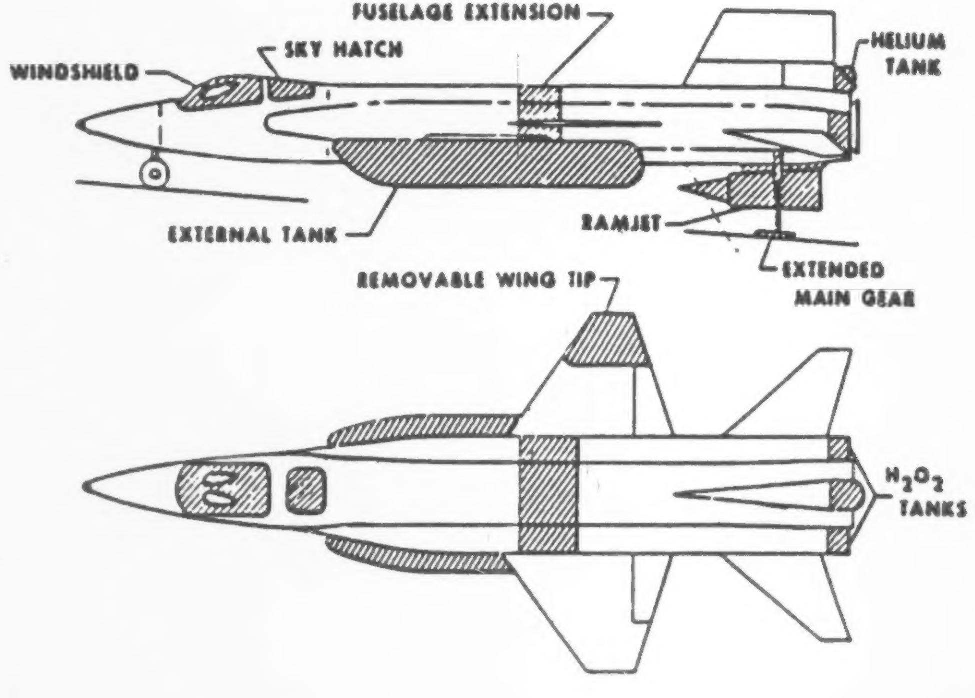
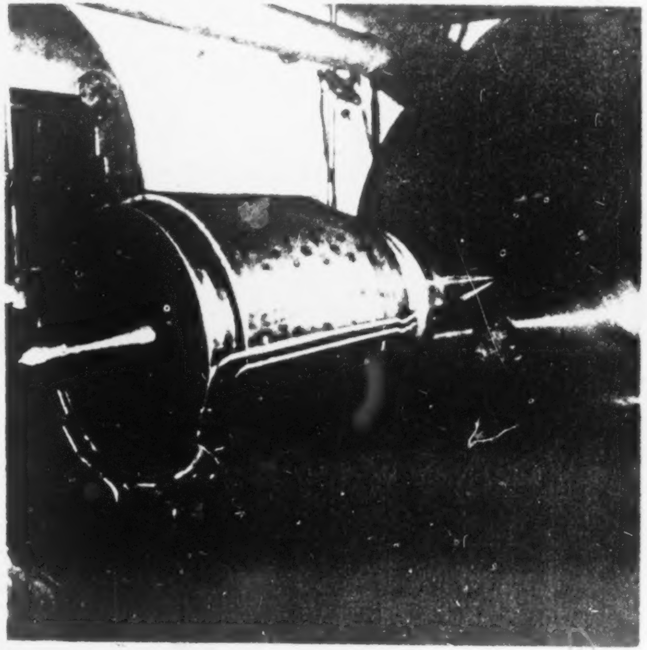

FUSELAGE EXTENSION
SKY HATCH
WINDSHIELD
HELIUM TANK
EXTERNAL TANK
RAMJET
EXTENDED MAIN GEAR
REMOVABLE WING TIP
H_2O_2 TANKS

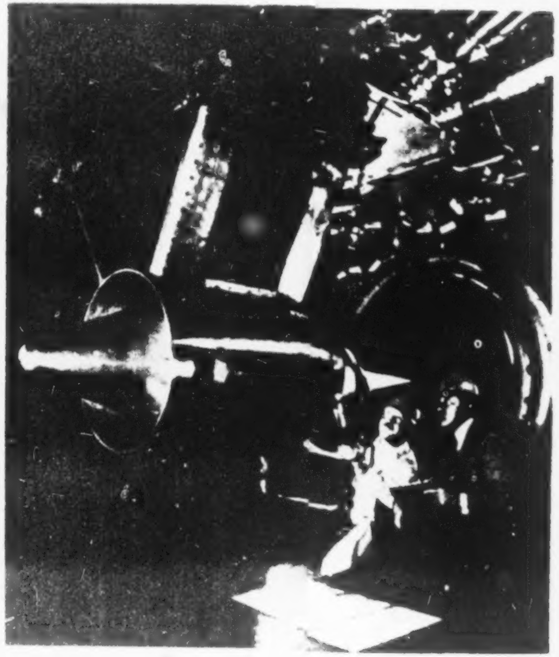
Figure 5

NASA HYPERSONIC RESEARCH ENGINE PROJECT



STRUCTURES ASSEMBLY MODEL (SAM) IN LANGLEY 8-FOOT HIGH TEMPERATURE STRUCTURES TUNNEL

- MACH 7 STRUCTURAL TESTING OF THE HYDROGEN-COOLED, FLIGHT-WEIGHT HYPERSONIC RESEARCH ENGINE
- THERMAL PERFORMANCE AND THERMAL FATIGUE DATA
- 18-INCH DIAMETER AT COWL LIP - 86-INCHES LONG



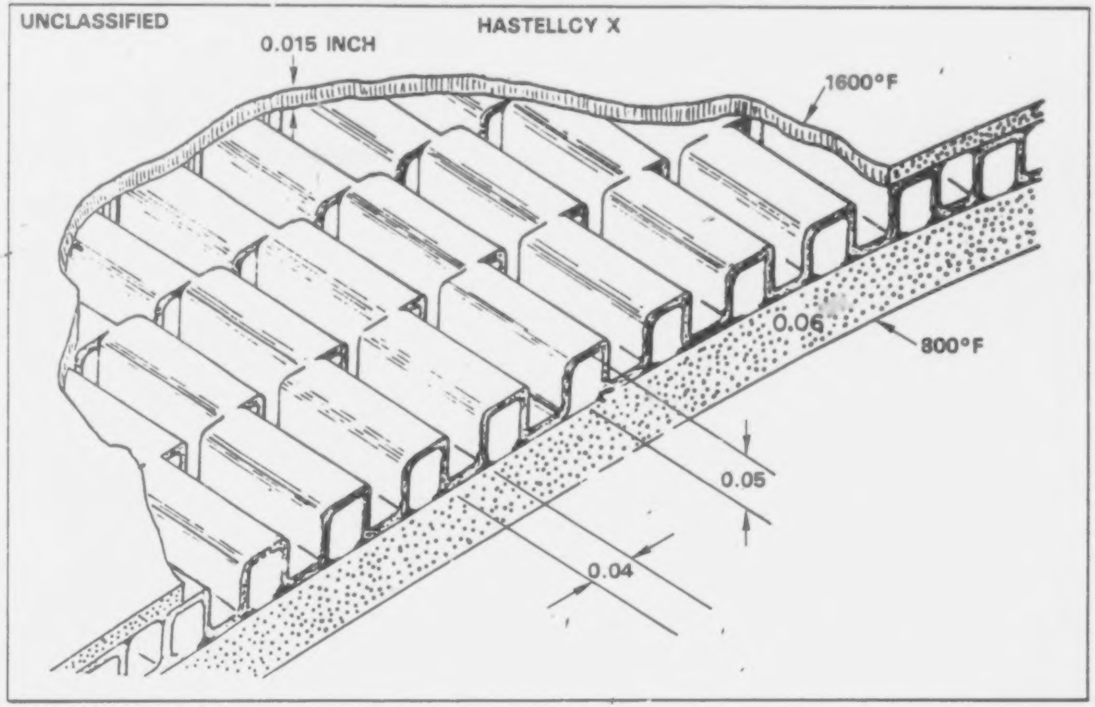
AEROTHERMODYNAMIC INTEGRATION MODEL (AIM) IN LEWIS PLUM BROOK HYPERSONIC TUNNEL FACILITY

- MACH 5, 6 AND 7 ENGINE PERFORMANCE TESTING OF [illegible] WATER-COOLED, HEAVY-WALL HRE
- HYDROGEN-FUELED SUBSONIC AND SUPERSONIC [illegible] PERFORMANCE DATA

Figure 6

UNCLASSIFIED

HYPERSONIC RESEARCH ENGINE
HYDROGEN-COOLED SHELL STRUCTURE (U)


UNCLASSIFIED
HASTELLCY X
0.015 INCH
1600°F
0.06
800°F
0.05
0.04

duPONT AEROSPACE CO., INC.

UNCLASSIFIED

Figure 7

component weights of the HRE engine shipped to Langley in 1968. To reemphasize the point, no wishalloy was used.

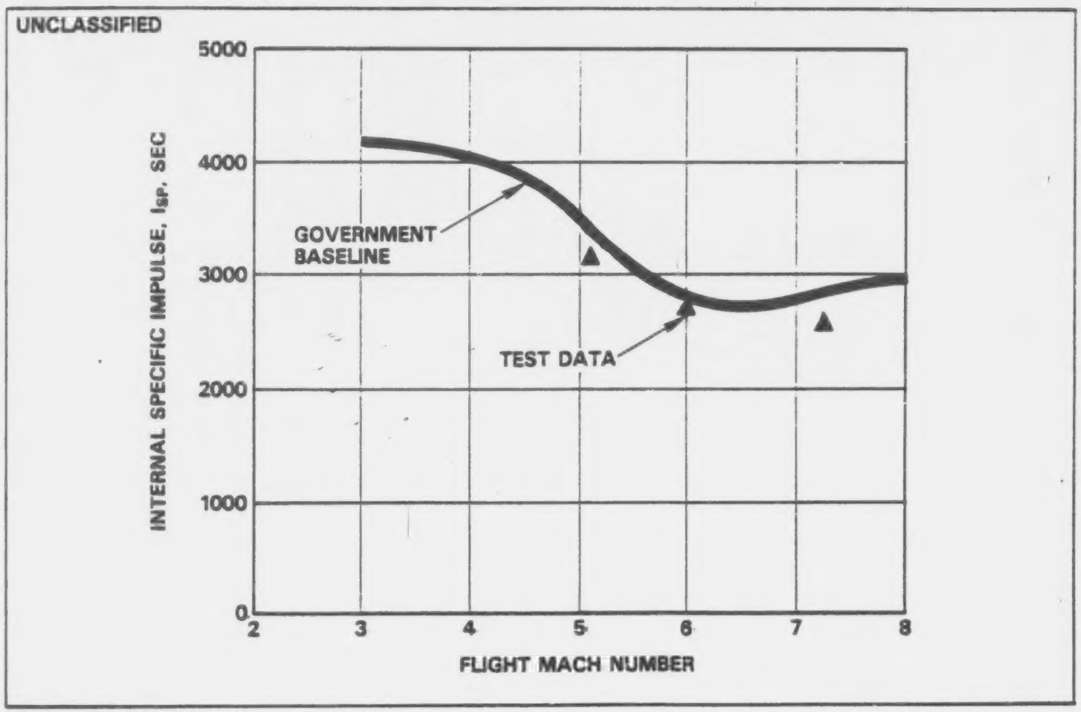
3.0 WHERE CAN WE GO FROM HERE

I have been asked to deliver an assessment of the future prospects for the NASP program. There is no question that an aircraft can and will be built that achieves something close to the original program objectives. There is a question as to whether it will be built by the United States or by somebody else. A few weeks ago I taught a course in hypersonics for the University of California. In the class were senior engineers from France, Sweden and Japan. They were quite proud of their countries' efforts to create an airbreathing space launch system.

In order for this airplane to be built in a timely manner by the United States it must not only be adequately funded, but there must be a strong focusing of the effort. We can only testify to what might happen if we had been given contractual responsibility to build and flight test the aircraft and its engines. We prepared the original cost and schedule estimates for DARPA based on the HRE and other experimental aircraft experience. The program contemplated three flying aircraft with first flight three years after contract authorization and a three year flight test period in which the flight envelope would be gradually expanded until orbital flight was achieved. Time and funding were allocated to make structural and aerodynamic changes as the flight test information indicated. We do not expect to know everything prior to flight. The total estimate was under $1 billion. We see no

UNCLASSIFIED

GOVERNMENT BASELINE ENGINE PERFORMANCE VS. HYPERSONIC RESEARCH ENGINE TEST DATA (U)



duPONT AEROSPACE CO., INC.

UNCLASSIFIED

Figure 8

reason today to significantly change that estimate, if we had complete responsibility for the program.

In the context of the large national program that NASP has become where participation of all five of the existing major contractors is a basic feature, we estimate that the program can be accomplished for $3 billion if, and only if, a fully technically qualified organization is in charge of the program. We see very important contributions that each contractor can make to a successful program, but we see none of the competing companies qualified to run the entire program. This airplane is built around the engines, and highly professional engineering experience in both SCRAMJET engines and airplane design and construction is required to make the necessary design decisions.

What we have observed as an integral member of the Government Team is airplane and engine organizations trying to optimize their portion of the aircraft, frequently at the others expense. Attempts by the government to intervene and hasten a satisfactory design compromise usually have had negative results. We therefore do not look to the Government as the solution to this problem. In our view the only viable solution is an overall system contractor who is responsible for results.

This is the last frontier in aviation. Let's not lose it.

LASER
Radio
203·324·2417

Mr Scott Crossfield
U.S. House of Representatives

7/2/89

Dear Sir,

Thank you for inviting me to submit this letter for the permanent record of the hearings on the NASP/X-30. As you know, I've now spent three years researching the history and technology of hypersonic flight; for the book and video project, "Spaceplanes". I am convinced that the world is now on the threshold of a new phase in social evolution which will demand new methodologies, organization and funding of successful technology research and development. Hypersonics may be the first of what I call a family of "Ultra Technologies" (which also include fusion, genetic mapping, etc).

Just as the Manhattan Project created the institutional foundations for post-war high-tech systems engineering, the NASP/X-30 has the potential of being the prototype for future, highly-integrated, international and expensive ultra tech systems. Hypersonics is too expensive and difficult to manage for a single agency-- and most countries-- to pursue alone; thus cooperation is a hallmark. The ramifications of hypersonics and the spinoffs from it are also too great to permit political leadership to fall back on simple-minded slogans, propaganda and outright B.S. in its efforts to "sell" it! Under Reagan, the "Orient Express" debacle created so much intellectual pollution that it became virtually impossible at international conferences to usefully discuss matters like airspace legality, treaty obligations, etc. Now, under Bush I've seen absurd-- BUT STUPIDLY PREDICTABLE-- nonsense about flying from Washington-to-Fulda Gap in forty minutes. Only a Beltway Bozo would take that trip! Omaha-to-Moscow in 30 min? We already have ICBM's for that! Manned hypersonic "bombers" are dangerous fantasy creations of the same kind of day-dreamers who have been pushing such (destabilizing) nonsense ever since USAAF Colonel Don Putt brought the captured Luftwaffe/Sanger RABO blueprints back to Dayton after World War II.

It's time for the U.S. Congress to demonstrate leadership. The NASP is an investment in the future. It is a research program... period! Tell DOD and NASA to proceed and STICK WITH IT! Keep the management under USAF, because the NASA vertical-launch and space station folks would just as soon see NASP die a quick death. Finally, for God's sake, let's start seeing EDUCATION-- NOT PROPAGANDA-- and help prepare the people of the United States and the world to "Draw-out" (Educare') from their own experience... the perception that there is a NEED for hypersonics and the other technologies that will transform their lives in the next century. We don't need stupid militaristic fantasies. The Reagan "Star Wars" years are over! Glass and ceramic makers should see the benefits of NASP to them; combustion engineers the same; business people all over the world should see investment potential in NASP-related spinoffs. The current mode of propaganda, literally inherited from the "German Rocket Scientists", is as outdated as the notion of a manned hypersonic bomber or reconnaisance plane. We can't even afford B-2's! What the world needs is a faster way to get across the Pacific on business!

Thank you very much for allowing me to express my views.
Sincerely, JOHN A. GUTHRIE

BOX 1262 STAMFORD CT. 06904